Plate I. The native bison, noblest of American quadrupeds, and the only North American mammal that promises to contribute much to agriculture. (See page 287.)

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PART I

THE ANIMAL AND ITS RELATIONS

There are about 12,000 known living species of mammals and about 15,000 species of birds. From the time when man began to emerge from the lower creation, he has possessed and enslaved his fellow animals. Great numbers of species have been brought into captivity, yet it is surprising how few of these have really been domesticated. The Editor of this book has made a diligent effort to record every species of animal of any kind that is now domesticated for agricultural uses in North America (north of Mexico), and he has interpreted the field of agriculture broadly; yet the book does not contain accounts of twenty really domesticated species of mammals, not more than a dozen of birds, only one species of fish, and two of insects. In other words, the numbers of species of animals of all classes with which North American agriculture is really concerned do not much, if any, exceed thirty, or say, one species to every one thousand species of mammals and birds that are known to exist on the earth today. This means either that the domesticable species are exceedingly few, or that man has not yet improved his opportunities in adapting the animal kingdom to his uses; or else that his necessities are now all supplied.

More than thirty species are described in this volume, however, but many of them are not domesticated, and others are not really agricultural animals. Some occupations or sources of income directly or indirectly associated with agriculture -- in the sense of being the products of land more or less under the control of man -- rest on the capture or exploitation of wild animals. Of such are the fur-bearing animals, although some fur-bearers are bred under captivity. Other animals included in this volume are pets or companions, and are agricultural only in the sense that they may be bred and

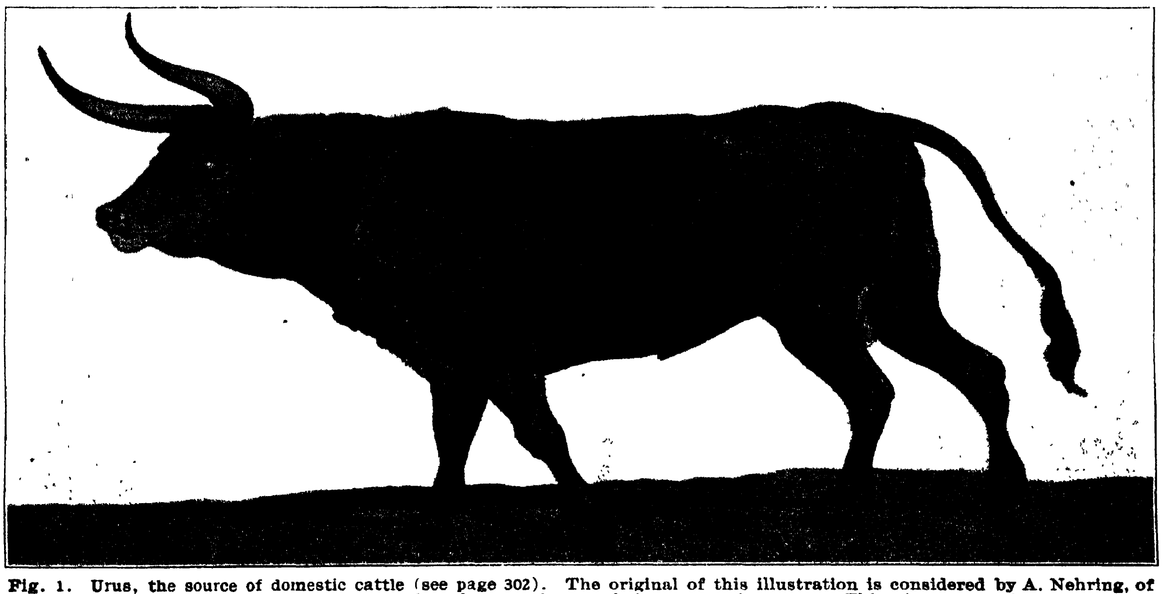


Fig. 1. Urus, the source of domestic cattle (see page 302). The original of this illustration is considered by A. Nehring, of Berlin, an eminent authority, to be the best known picture of the now extinct urus. This picture was found at an art dealer's establishment in Augsburg, Bavaria, in 1827, and was published in Vol. 4 of Griffith's edition of Cuvier's "Animal Kingdom," London, 1827; and from Griffith's print the above illustration is made, somewhat reduced. This picture was probably made for an Augsburg merchant about the year 1500. Three more or less reliable pictures of the urus are known. (See Nehring, in Landwirtschaftliche Jahrbücher, Vol. 25, 1896, p. 927.)

sold by land-owners. Certain wild animals may be merely controlled or protected to a certain extent, when conditions require it, and their propagation and welfare are thus promoted. Of such are the various animals classed as shell-fish and frogs and turtles. Some animals, as fish, may be bred or propagated under captivity and then turned loose. Some animals are bred in captivity only to supply zoölogical parks and game-preserves, as pheasants, bison, wapiti or elk. The rearing of animals for park purposes is in the hands of a few specialists here and there, and the subject has not been discussed in this volume to any extent. Many of them are kept as curiosities, because of some special interest that attaches to them rather than because of any immediate economic value they may possess. These animals have not been truly domesticated, and the rearing of them consists, for the most part, in protecting the animals and in learning enough of their habits to enable the operator to supply their natural wants and to facilitate their breeding.

The Americas have contributed very few agricultural animals. The most important examples are the llama (Fig. 11) and turkey (Plate II), the former not being reared in the territory covered by this work. The bison (Plate I) is capable of domestication, and the hybrids with domestic cattle promise to produce an agricultural race. The elk is easily tamed and kept. The meat is good, and the animals may be readily broken to drive. The cochineal insect of Mexico has been much grown, under conditions of control nearly as complete as those that are organized for the rearing of the silkworm; but it is doubtful whether the animal can be said to be domesticated in the sense of having produced domestic variations or races; this insect is less reared in Mexico than formerly, owing to the competition of the chemical dyes. Many of our wild animals could undoubtedly be domesticated if the effort promised to be worth the while. Of such, for example, are the musk-ox of the arctic and sub-arctic regions, with good flesh and very useful pelts; species of the deer, antelope and moose tribes; prairie chicken, one of the staple game birds and said to be readily tamed; wild geese and ducks; various other game birds; species of fish.

It is worthy of note that certain families have contributed most of the important domestic animals, as, for example, the Bovidæ, including the bovine or cattle-like and sheep-like ruminant animals; the Equidæ, including the horses and asses; and the groups comprising the domestic fowls and the ducks. Certain great families or groups have contributed few or no domestic animals. No real agricultural animals are of the Carnivora, although the dogs and cats belong to that group. The great group of rodents has contributed only the hares, although cavies, rats and a few others, are reared as cage animals. The sea has yielded no domestic animal; and the fresh water has given only the carp as a domesticated food fish. Although man has always captured and enslaved others of his own kind, no species of the man-like animals, as apes, have ever been domesticated.

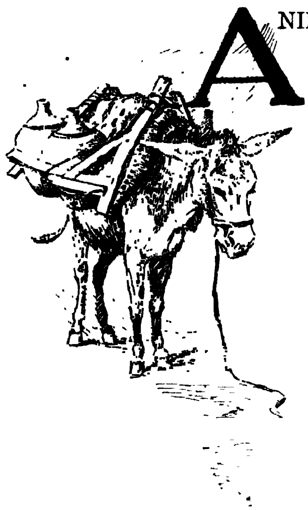
Contrary to his expectation, the Editor has found the compilation of this volume much more difficult than the making of the volume on crops. Animals are less tractable to investigate than plants, and the scientific method does not seem to have been so successfully applied to the study of them as to crops. In the matter of breeds, the expert knowledge is likely to be in possession of advocates or even of partisans, and it is very difficult to arrive at agreement or a common basis of comparison and judgment. Existing writings are largely descriptive and historical. Even on questions of feeding and general management, there are almost irreconcilable differences of opinion. The Editor hopes, however, that the compilation has brought together the soundest opinions and practices, and he is sure that the names of the contributors to this volume will make the work authoritative. The articles on breeds are largely from men engaged in practice and from specialists in the breed, whereas the articles on crops in Vol. II are largely from teachers and investigators; this dissimilarity is representative of the kinds of interest that attach to these two great groups of agricultural products.

Any work of this kind is necessarily tentative. It is intended that it shall express and record the status of live-stock knowledge of the present day. The reader must make his choice if opinions conflict. The reader may be confused by the lack of a strictly alphabetic arrangement, but such arrangement is impossible, as he will discover if he tries seriously to make one: he will find that the index will land him at the right place. The Editor will be glad of any suggestions that may enhance the value of future editions.

CHAPTER I

THE DOMESTICATION OF ANIMALS

By W. H. BREWER



ANIMALS ARE BRED BY MANKIND FOR NUMEROUS USES AND FANCIES. Although common biological laws govern all higher animals, wild and tame alike, the truly domestic animals constitute a class by themselves, differing in several characteristics from wild ones or from the direct offspring of wild ones that have been tamed individually by man for similar uses and fancies. All species of animals and birds can probably be tamed as individuals if we begin at the right period of their lives; yet few have been transformed into domestic animals.

As defined here, the term "domestic animals" implies that the animals may be bred by man for an indefinite number of generations. They are the animals cherished in our homes and on our farms, and belonging solely to the higher groups of the animal kingdom, the mammals and the birds. Animals belonging to a few other species are so abundantly tamed and used for the same purposes as truly domestic ones, that in common speech and in certain laws and ordinances they are made domestic animals for legal consideration, inasmuch as they may constitute property. Indeed, many species that are naturally wild may be bred and protected in captivity for a certain time and then allowed to live the remainder of their lives as wild ones. Various kinds and species of birds and animals for hunting, turtles among the reptiles, honey-bees and silkworms among insects, fishes and lobsters in the sea, even so low as oysters in our harbors, are multiplied by artificial means on an enormous scale, protected for a time from the many dangers that beset them, and then turned loose to spend their lives as wild creatures. They are sometimes classed legally as domestic animals and sometimes not.

Characteristics of domestic animals.

The term "domestic animals" as here used and limited practically applies to a distinct class having aptitudes and characteristics that distinguish them from wild and even from tamed individuals. These special characteristics differ greatly in degree according to the species or the breed. Two especial characteristics they must have, and incidentally a third they do have, especially those long bred by man. First, they must breed freely in captivity for an indefinite number of generations; second, they must be able to thrive under the artificial conditions man imposes; third, and incidentally, they are naturally tamer, and their instincts are often modified and some are lost. The mental capacity for education with some species is also modified, better to adapt the creature to man's uses and fancies. Although many animals are tamed for use, but relatively few species have been transformed into domestic ones as here defined. Innumerable unsuccessful experiments have been made with many species. Carnivorous animals, have been trained for the chase for ages, and herbivorous animals have been semi-domesticated for a long time, but may never have become strictly domestic. The number of species that have become truly domestic is perhaps not greater than three score in all the many thousands known to science. The actual number of species that are used is scarcely two score in any one country.

(1) While very many species have been tamed by man to do his bidding, which live long and healthy, and, as far as we know, happy lives, very few breed freely in captivity. Some never breed at all; of those that breed at all, the offspring die young or the descendants die out in two or three generations. For example, the tame elephant has rarely if ever raised offspring. Of all of the animals of the cat kind, but a single species has ever become "domestic," although enormous numbers have been tamed and many of them have produced young. This same law holds good for birds. On the contrary, domestic animals increase greatly in their fertility when such increase is desirable, hogs among mammals, hens among poultry, being sufficient examples.

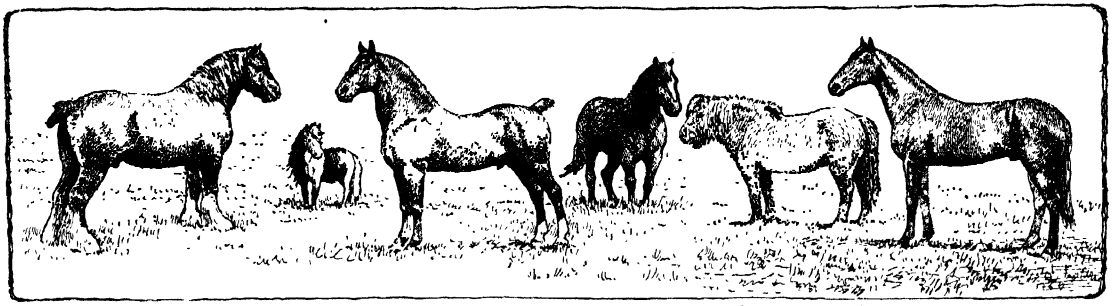


Fig. 2. Variation in the horse, from draft horse to trotter, coach, Celtic pony and Shetland pony.

(2) The second requirement needs no explanation. For example, take the horse. While probably originally a native of an open country and leading the freest of lives and easily reverting to wildness, yet in domestication it will live to healthful old age in stables or other enclosures, and in unnatural conditions. It will live in mines without light for years, and under the artificial conditions of cities for a longer term of life than it ever could have done as a wild horse. During the long ages and the many generations that they have been bred by man, some animals have slowly become adapted so completely to the conditions man has imposed that now many kinds could not exist for two generations if turned loose in any large country of the world, to make their own living and to bring their young to maturity.

(3) Their instincts and mental requirements have been modified. Some have lost instincts that were useful in their wild state but have now become reduced from lack of use. Thus they become, as a whole, a new class depending on mankind. He is, in one sense, their creator. They would not have existed but for him. He provides their parents; he furnishes them their food; he protects them from the dangers that await them in nature; he builds shelter from storms for them; he educates doctors to cure them when ill, and to prevent their epizoötic diseases. They are an artificial production. Nature has provided man with the raw material; he has turned this to a more ideal and useful animal for his purposes. It is tamer to deal with; it is less intelligent as a whole than the wild creature that was its ancestor. Its form, its strength, its size, its various physical characteristics and mental capacities have been molded, the better to suit the environment and the better to serve the uses and pleasures of mankind. These improvements have been made according to the ideals of the people among which the animal has been developed. In its relations to mankind as well as to nature, it is as truly artificial as is wood or stone wrought to new shapes and adapted to new uses or new ideals.

Plasticity of animals.

In the scheme of nature, each species is given a certain degree and kind of plasticity as it were, by virtue of which it adapts itself to a new environment when the old one changes. The whole dogma of the evolution of species in nature is founded on this law. Species differ in the degree of plasticity, but every species and every individual of each species has it to some degree. If the environment changes faster than the species, then in nature it dies out. A very large proportion of the wild animals in exis-

Fig. 3. Variation in the sheep, showing fine-woolled wrinkled Merino, long-woolled Black-face Highland, flat-tailed Persian, small Faröe island sheep, and a four-horned sheep.

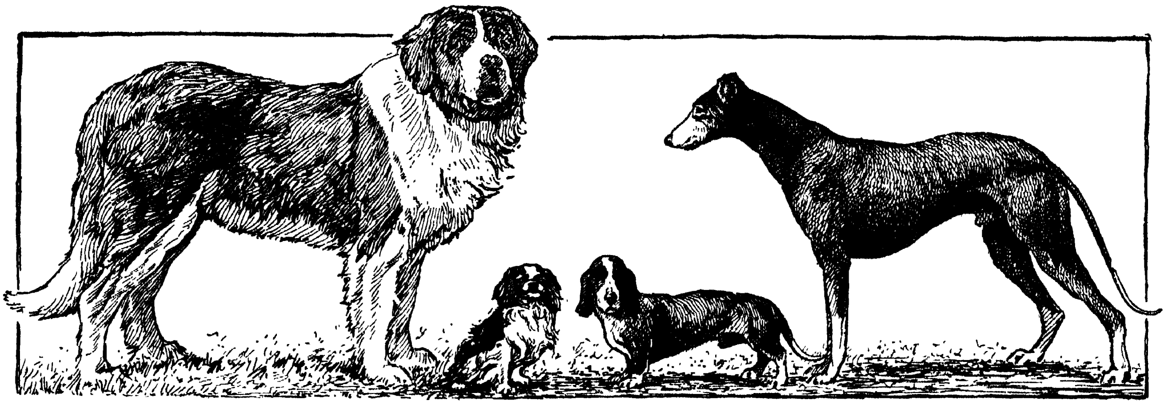


Fig. 4. Variation in dogs, represented by St. Bernard, poodle, dachshund, greyhound.

tence cannot change from their wild to a domestic environment fast enough for man's convenience and profit, and hence we have domesticated but few species. The most of the useful species we now have were domesticated so early that we have no record of the process. Most kinds originated in the Old World. But few have been domesticated since the Christian era. America, since its discovery, has contributed three — the turkey, the guinea pig and the llama.

Some breeds we wish to keep essentially as they are, and further improvement is practically limited to retaining and enhancing the special excellencies now possessed. For such we have devised a way of preserving the breeds pure by means of pedigrees, recorded in studbooks, herdbooks, or other publications. Along with the pedigrees, for some breeds we record the excellencies of the individual animal thus registered ; and we have also devised ideal "scales of points" of especial excellence to be recorded.

History of mankind as affected by domestic animals.

The part that domestic animals have played in the history of mankind is intensely interesting. What kind of civilization might have risen without them is scarcely a subject for speculation. Low savagery may be lifted into a respectable scale of barbarism by them. We have many illustrations of this ; the most familiar is that of the Indians of the plains. Those of a century ago were feeble tribes, following the bison on foot and with dogs, and remained feeble until they adopted the horse ; then they became the most powerful foe to the advance of the white race in America.

The material foundation of civilization is agriculture. In all civilized countries, agriculture is considered in its two great branches,—the production of animals and the production of crops. With animals alone, a tolerably respectable barbarism may be attained, intermediate between savagery and civilization. In all ages, and especially in new communities, there is a certain antagonism between the two branches. It is a belief with many persons that the story of the first human conflict in history is an allegory of the conflict between the grower of live-stock and the tiller of the soil. That conflict goes on still between roving peoples and settled farmers ; and the story of Cain and Abel is reflected in our own peaceful times in the "fence" and "no fence" struggles in this country. When the "man with the hoe" ultimately prevails, as he always does if the climate permits, it does not mean the expulsion of the animals, but merely the restraint of the owner.

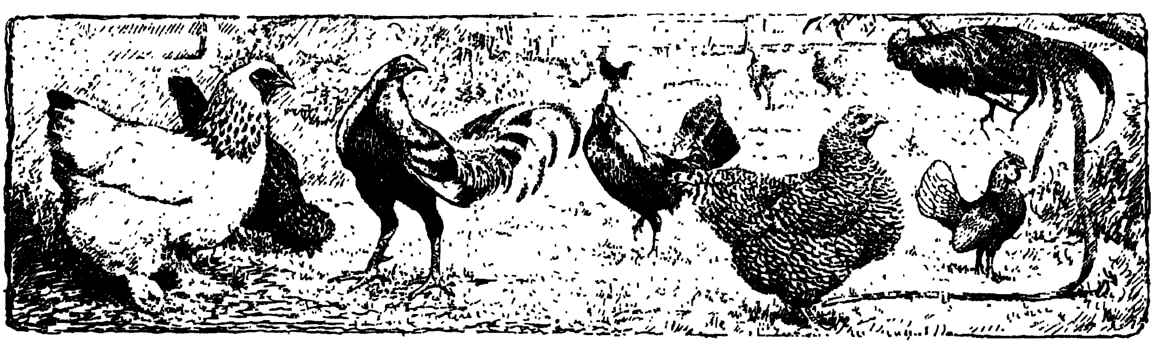


Fig. 5. Variation in fowls, showing Light Brahma, bantam, game-cock, long-tailed oriental fowl, jungle-fowl and others.

In this country, the economic relations of farm animals to material wealth is interesting history. In colonial times, they and their products formed a relatively small part of our foreign exports. So, too, during more than one-half of our existence as a republic, the exports of animal products constituted a small part of our agricultural exports. It is only within the last few years that the animal products have constituted such a large percentage of our home wealth and our export trade. From the nature of the case, the industry must increase with the growth of the country. Large areas are suited for pasturage which cannot be devoted to tillage. In the great areas tilled, the production of animal products will fluctuate as other products fluctuate in production, according to the rules of economics. Under present and increasing knowledge, the production will surely increase in excellence and in quantity.

In considering their purely economic relations to mankind, the capital they represent, their value as property, they are so widely distributed and so vast in their numbers that the immense total can only be guessed. We have many statistics relating to the farm animals of various civilized countries,—statistics, so-called, but in fact statistics of only a part and estimates of the remainder. This is true not only for their numbers but also for their money value. With some kinds, as poultry, for example, while grown for their economic value, we have so little knowledge as to the actual numbers grown in the world that we have never seen so much as a guess as to the number.

With other of the domestic animals useful to man, as cats and dogs, sentiment as well as use plays an important part. This is especially true of the latter animal, the most widely distributed among mankind and of every grade of usefulness. Among certain tribes and peoples dogs are the most important part of their material wealth, their very lives depending on it. They could not exist in the country without their dogs; and so through every grade of economic use down to the pets of expensive luxury. While insignificant in size, little, perhaps, in usefulness, nevertheless the dog is sometimes rated at thousands of dollars for a single animal. So it is with various other pets also, as the canary, for example, —one of the most harmless luxuries of rich and poor alike, representing no economic use, yet whole communities living on its breeding and education.

Domestic animals have played an interesting part in the religions, myths, and superstitions of mankind. How early this relation began, we do not know. We need not trace it back before Zoroaster wrote, nor discuss the part it played in the old civilization of Egypt and Assyria. It is enough to say that it still exists in every degree of intensity of belief, from that which considers the slaughter of sacred cattle and the eating of their flesh a most heinous sin and crime, down through every shade of belief to the innocent superstition that many persons do not like to tolerate or even to see a black cat. Its importance in some countries as a religious belief is such that it has been an excuse for war.

Pedigree.

A pedigree is a record of the parents and ancestors of an animal for a specified number of generations, extending through all the lines of descent. In all our important breeds, ancestry has been the prime factor in their making and betterment. From the nature of the case, each breed has been a long time in the process of formation, and has been produced by the selection of parents and ancestors.

For the preservation of the purity of the breeds and to enhance their excellencies, a system of recording the pedigrees of animals has been devised. Studbook, herdbook or register, is the general term applied to the record in which all the individual ancestors are named, while flockbook or similar term is used for the record of such classes of animals as sheep and swine, of which whole flocks may be recorded as a unit. Without the help of these or similar publications, the present excellence of most of our better breeds could never have been attained nor their excellence preserved. The greater the purity of the breed, the greater the probability of the transmission of its peculiar excellencies; and there has been no better way devised to lessen the uncertainties of breeding, than through purity of pedigree. Variation is so universal that no two animals are ever exactly alike. Some are better than others. Crossing breeds or varieties of animals promotes variation; hence, any breed is more uniform and fixed in character than are mongrels, which represent the extreme of indiscriminate crossing. Among the latter we sometimes find an animal very much better than its parents and the average of its ancestors; but it rarely or never transmits its excellencies to the majority of its offspring.

The keeping of studbooks for horses began with that of the English Thoroughbred in 1808. With cattle, the Shorthorn herdbook was begun in 1820. At the present time, similar publications are issued for many breeds and species of farm animals. The aim of all is the same: To make the breed more uniform, to improve it until it reaches the highest practical excellence, and to increase the proportion of animals in it which reach an excellence near the highest.

THE PLACE OF THE DOMESTIC ANIMAL IN OUR CIVILIZATION

By *Thomas F. Hunt*

Domestic animals may be considered in three aspects, namely, (1) their relation to human development, (2) the extent and progress of animal husbandry in the United States, and (3) the relation of domestic animals to farm management. Figs. 6–17 suggest some of the animals and their uses that are closely related to human development.

(1) *Animals in their relation to human development.*

Animals as a primary motor.—If one visits a certain farm along the Olentangy river in Delaware county, Ohio, he will find other evidences of a former race of people than that indicated by the good Indian names. Here may be seen a large circular embankment which, in connection with a bend in the river, encloses perhaps twenty-five acres of land. The high bluff, which here constitutes the bend in the river, suggests the use to which it may have been put, especially as no other such vantage ground exists for miles around. The large embankment, several feet in height and width, now entirely overgrown with timber, required a large amount of labor in its construction. A building contractor, who appreciates the amount of work required to move a small amount of earth, remarked that it would take a great deal of labor with teams and scrapers to make such an embankment. The reply was that the people who made this embankment did not have teams, much less scrapers, with which to do the work. These North American Indians built their fortifications, as well as their mounds, without draft animals or beasts of burden.

Fig. 6. Dogs as a primary motor.

While the Indian was not lacking in native ability or even a considerable degree of intelligence, it may be confidently asserted that, under such conditions, he never would have developed beyond the stage of barbarism. Because there were on the American continent no domestic animals except the dog and the comparatively inefficient llama and alpaca, the peoples of America failed to develop as did those in the Old World. Domestic animals are a prime requisite of civilization. Man has developed just as rapidly as he has been able to subjugate the forces of nature to his own use. Working alone and unaided, man would have a sorry existence. By the aid of domestic animals he has been able to increase his productive power. Formerly, transportation that was not by boat was largely on the backs of animals, the draft animal being chiefly used at the plow. Since the moving of commodities has come to be done largely on wheels, and since coal, oil and gas have been applied to the moving of wheeled vehicles, and more recently a large application of falling water through electric transmission to the same purpose, the use of animals as a motive power has declined relatively.

Notwithstanding the tremendous improvements in transportation by means of mechanical motors which took place in the last half of the last century in the United States, the number of horses in proportion to population has not changed materially. This is more significant in view of the fact that so much larger proportion of the population now lives in cities. The following table gives the number of horses and mules in the United States, exclusive of those in cities, the population of the United States, and the number of persons in the United States for each horse or mule kept on farms:

	Horses and mules, mill	Population, millions	Persons per horse or mule on farms
1850 . . .	4.9	23.2	4.8
1860 . . .	7.4	31.4	4.2
1870 . . .	8.2	38.6	4.7
1880 . . .	12.2	50.2	4.1
1890 . . .	17.6	62.6	3.6
1900 . . .	20.0	75.6	3.8

The fact that horses continue in as large numbers as ever, relative to population, is due to a well

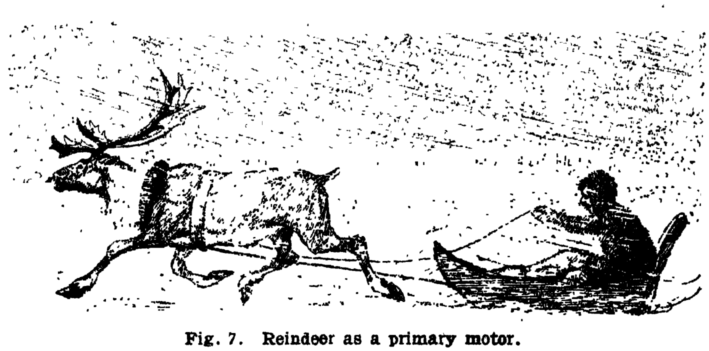


Fig. 7. Reindeer as a primary motor.

known attribute of human progress. The activities of man increase with his ability and his opportunities. A number of instances have been reported in

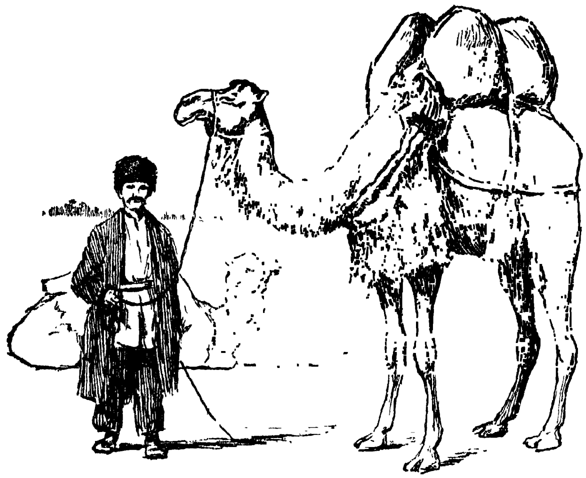


Fig. 8. Camel as beast of burden.

which better and cheaper parallel transportation has been provided without reducing materially the transportation on the original road. The better and cheaper facilities not only cause more people to travel but also the same people to travel more often. Every invention which enables mechanical power to supplant animal power is a distinct advantage to society. The great advancement in material wealth in recent times has been due largely to the increased application to the world's work of the stored up carbon derived from coal, oil and gas. It is not probable, however, that these improved methods will supplant horse-power. They will merely augment man's resources.

Animals as a source of clothing.—Animals have enabled man to conquer nature not only by adding their force to his relatively weak body, but they have furnished him clothing which has made it possible for him to extend his habitat. The extensive cultivation of cotton, which came about in the nineteenth century, has made wool and silk relatively less important, but it may be doubted whether the demand for leather was ever greater

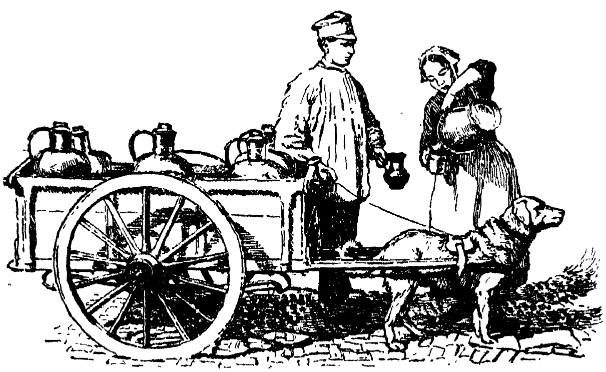


Fig. 10. The dog as a working animal. "A dog of Flanders."

than at the present time. In this age of substitutions there have been few attempts to supplant leather. Although relatively less extensively used than formerly, silk and wool possess qualities found in no other fiber. Flax has suffered more than silk and wool from the competition of cotton.

Animals as a source of food.—Much the larger part of the vegetation which grows on the earth's surface is unsuited for human consumption. According to the United States Census in 1900, only 12 per cent of the land surface in this country was cultivated in any other crop than grass; therefore 88 per cent of the land area was either woodland, grassland, or waste land. Of the 12 per cent in farm and garden crops other than grass, 10 per cent was in cereals. A large part of these cereal grains and parts of the straw and stover are converted into milk, butter, cheese, meat or animal fats. As an example, over 80 per cent of all the corn raised in the United States is consumed in the county in which it is raised, a large part of this being fed locally to the domestic animals. Not only do animals add to the quantity of available food, but it must be admitted that their flesh and other products have added greatly to the quality of man's dietary. Among all the food products of

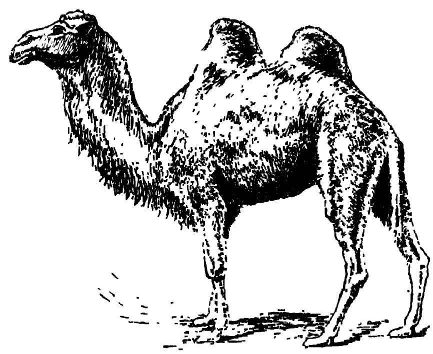


Fig. 9. Bactrian, or two-humped camel.

man, none are more efficient or more refined than dairy and poultry products.

The domestication of animals has also added to human progress by increasing the stability of the food supply. Like grain elevators in primary markets, domestic animals are storehouses of food to be called on when soil products are temporarily limited, and allowed gradually to accumulate when these products are plentiful. A nation in which a considerable part of its food supply is stored in meat-giving animals seldom suffers from famine.

Animals as civilizing agents.—While domestic animals have occupied such an important rôle in advancing the material welfare of the human race, they have not been less important to our spiritual welfare. Whether animals are kept merely as companions (pets) or as slaves (for labor, clothing and food), they compel habits of care and responsibility and inculcate habits of mercy. Such habits are essential to the highest success in the rearing of dumb animals. These habits, together with the sympathetic influences involved, in all ages, have

had and still continue to have, an elevating and civilizing influence. Shaler puts it thus:

"It is perhaps too much to attribute the advance of the agricultural classes of our civilized peoples, in all that serves to remove them from the brutality of their savage ancestors, altogether to the nature of their work,—to the very large element of kindly care for which it calls, and which is the price of success in the occupation. Yet when we note the immediate way in which the people bred in cities, under circumstances of excitement are wont to behave like savages of the lower kind, showing in their conduct a lack of all sympathetic education, and contrast their behavior with that of their kinsmen from the field, we see essential differences in character which cannot well be explained save by the diverse natures of the training which the men have received. Thus, in the French Revolution, the baser, more inhuman deeds were not committed by the peasants, who had been the principal sufferers under the régime which was overthrown, but by the people of the great towns who had been less oppressed by the iniquities of the old system of government.

"If it be true, as my personal experiences and observations lead me firmly to believe is the case, that man's contact with the domesticated animals has been and is ever to be one of the most effective means whereby his sympathetic, his civilized motives may be broadened and affirmed, there is clearly reason for giving to this side of life a larger share of attention than it has received."

Characters essential to domestication.—Besides having the ability to make effective use of the available food and render this food into products or service useful to man, animals must possess other characters to be domesticated. The most obvious of these characters are readiness with which they become subject to the will of man and their ability to breed freely and abundantly in captivity. The elephant is much more easily brought under the will of man than the lion or the jaguar, the horse than the zebra, the ox than the rhinoceros. Although one of the most intelligent of animals, probably because his brain has been trained in guiding his proboscis just as man's brain has been trained through the necessity of guiding his hands, the elephant has never been domesticated, and man has always depended on taking him into captivity from the wild state. The reason for this practice is that the elephant has seldom been known to breed in captivity. Further, an elephant is not matured until thirty years of age. Useful domestic animals breed freely in captivity and are fairly prolific.

(2) *The extent and progress of animal husbandry.*

Extent.—Practically every farm in the United States keeps domestic animals of some kind, either for their labor or their products, or both, and nearly every household in the land keeps one or more animals for companionship. On about one-third of the farms of the United States, constituting 47 per cent of the total farm area, 40 per cent or more of the gross income was in 1900 from animals or animal products. The total value of farm products produced in the United States was in round numbers $3,000,000,000, of which $1,000,000,000 was fed to live-stock. The value of animals and animal products sold and animals slaughtered on the farm was approximately $1,750,000,000. The value of animal products, therefore, is only slightly less than the soil products not directly

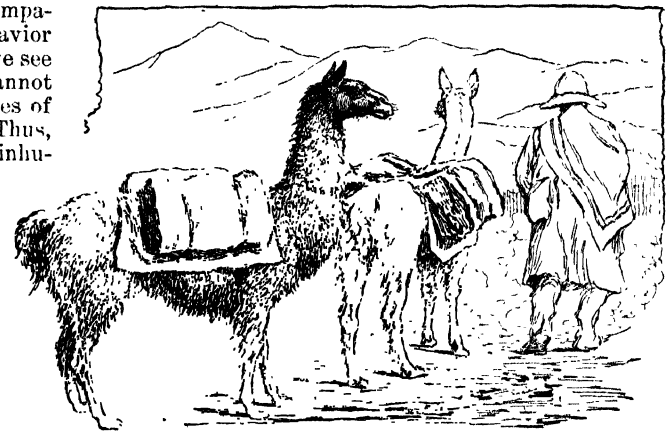


Fig. 11. Use of llamas as beasts of burden. South America.

fed to animals on the farm. Animals sold and slaughtered were valued at $900,000,000, dairy products at $472,000,000, and poultry and eggs at $180,000,000.

Increase in production.—For purposes of comparison, the statistics concerning domestic animals are unsatisfactory both because the basis of enumeration has varied and because it is uncertain just what the basis has been at different times. The Twelfth Census is probably the most complete and accurate enumeration of domestic animals that has ever been made, and hence some apparent increase in numbers may be attributed to this greater completeness of enumeration. Taking the census figures as they stand during the last half of the last century, horses and mules have increased about four times, neat cattle about three times, milch cows rather less and other cattle rather more than three times, while sheep and swine have each doubled in numbers in the fifty years. The population in the same period increased about three and one-third times. Considering horses, mules and cattle as units, and assuming five sheep and five hogs to be a unit, in 1850 there were 1.4 animal units per capita, while in 1900 there were 1.2 animal units per inhabitant.

Improvement.—While animals have increased about three times in numbers in fifty years, in value they have increased six times. In the same way, while the number of animals in proportion to farm area was the same in 1900 as in 1850, the value has doubled in proportion of the area of the land in farms. Perhaps part of this increase in

value is due to the greater cost of producing animals, but, without question, it is in part due to the greater intrinsic worth of the animals. In 1850, sheep in this country produced 2.4 pounds of wool

Fig. 12. Use of elephants in the forests of Burma.

per fleece; in 1900 they produced 6.9 pounds per fleece. While in fifty years sheep have not quite doubled in numbers, the amount of wool produced has increased more than five times. A large part of this improvement in wool production is due to breeding and not to feeding, and offers one of the most striking illustrations of the economic application of the principles of breeding. This constitutes a present to society on the part of American breeders annually greater than the combined charities of the captains of industry. The increase per cow in the production of milk, and more particularly of butter-fat, in the same period would hardly be less striking if statistics existed to show it. When the first American Fat Stock Show was instituted in Chicago in 1878, prizes were offered for four-year-old steers. Today, no Fat Stock Show in America offers premiums for a steer that has reached the age of three years. If animals can be matured in their third instead of their fifth year, it is obvious that a much less number of animals must be kept on the farm in order to supply the same number for slaughter. In 1848, Randall, writing of Cleveland Bay horses, then recently imported to America, spoke of them as enormously large horses. With the importation of Louis Napoleon into Ohio in 1851, the breeding of draft horses began in earnest in this country. The ordinary farm horse in America today is probably 25 per cent more effective than it was then. In riding thirty miles on a railway train in northern Illinois recently, twenty-five teams were observed working on the land. Two were two-horse teams, six were four-horse teams, and the remainder were three-horse teams. Thirty-five years ago in this region the common team was a pair of thousand-pound horses; today it consists of three horses weighing nearer 1,500 pounds each. This is an important factor in the economy of production and hence has materially influenced the price of land in that region.

Comparative progress.—While animals have not kept pace with the population in numbers, they have probably done so in intrinsic worth. Notwithstanding, the production of domestic animals has not kept pace with that of farm crops. Furthermore, the number of animals kept in the United States is much less per land area than in older countries. For example, in the United States there are nine acres of land, of which four and a half acres are improved, per animal unit, while in Great Britain there is one animal unit for every two and a half acres.

Recent progress.—It may be of interest to note the trend in numbers and values in recent years. The following table gives the estimates of the United States Department of Agriculture for 1897 and 1907, of the number and value of farm animals. These figures are estimates and not the result of enumeration. There is reason to think that part of the increase shown in the table is the result of changes in the basis of making the estimates rather than actual changes in the number and value of the animals themselves:

	Number, in millions		Value, in millions	
	1897	1907	1897	1907
Horses and mules	17	23	$550 00	$2,275 00
Milch cows . . .	15	21	370 00	645 00
Other cattle . .	31	52	508 00	882 00
Sheep	37	53	67 00	204 00
Swine	41	55	166 00	418 00
	141	204	$1,661 00	$4,421 00

This table shows a marked increase in the number of all classes of domestic animals during the decade, and the still more marked increase in values. Of this enormous increase in values—somewhat more than two and a half times in ten years—none is more surprising than that in horses and mules, which have, in the period named, increased over four times in value, while increasing 35 per cent in numbers.

Future progress.—The economic conditions incident to a rapidly increasing farm area have led to a distribution of domestic animals which is not likely to continue. While the white man has been subduing the North American continent, a large part of the meat- and wool-producing animals have been reared on soil still untouched by the plow. In 1875, about 65 per cent of the live-stock of the United States was reared east of the Mississippi river; fifteen years later, less than 38 per cent. In 1875, only 7 per cent of the live-stock was reared on the ranches of the far West; fifteen years later one-fifth of all live-stock was raised in this territory. Over this vast area, cattle and sheep have been reared without cost for land and at a trifling expense for labor. It was in 1805 that beef cattle first reached an

eastern market from beyond the Allegheny mountains. From that time until very recently, government land, or land on which conditions are similar, has constituted the cattle and sheep pasture of the nation. Here most of the sheep and many of the beef cattle have been reared, large numbers of which have been subsequently fattened on farms where hay and grain have been produced cheaply and in abundance. The reason for rearing meat and wool on these areas has not been due to their natural adaptation to the production of grass, but to the uncapitalized condition of the land and to the fact that animals could be cared for in large numbers, therefore at little expense for labor. During the last century, the farmers in the cultivated areas in the older section of the country have suffered not alone because of the lack of profit from the rearing of domestic animals, but also because the cultivated areas have decreased in the crop-producing power from the lack of sufficient numbers of domestic animals. There is every evidence that the number of domestic animals kept on a cultivated area has begun to increase in recent years. As the country develops internally, rather than tangentially, and as the capital invested in land and improvements becomes somewhat equalized, the breeding and rearing of young animals may be expected to develop in those regions where the soil and climate especially favor the growth of grass and forage crops. Those regions where cereals are produced cheaply and in great abundance will furnish the materials for fattening the cattle.

(3) *The relation of domestic animals to farm management.*

(a) *Purposes and advantages of keeping live-stock.*—(1) Animals furnish labor and food on the farm. Even when it is not considered profitable to rear domestic animals for sale, the cost of living on the farm may be reduced by the judicious production of the home food supply. The number of acres of land that can be cultivated by each horse manifestly depends on the character of the farming, the character of the soil and the topography of the land. In England it is estimated that two horses will cultivate eighty acres of light and sandy soil and sixty acres of heavy or clay soil. In the United States it appears that one horse or mule of working age is kept for every thirty acres of improved land. The horses are kept not only for their labor but also for breeding purposes. Formerly a considerable number of oxen were kept as draft animals on the farm, and even today about one animal in twenty-five kept for draft purposes is an ox. While, as a draft animal, the power which an ox can exert is relatively large in proportion to his weight, the slowness of his movement has caused him to be discarded with the increasing value of human labor.

(2) Animals make use of land that would otherwise be wholly or partly unproductive. Such, for example, is land next streams, land partially covered with trees, and land too hilly or too stony to cultivate. Even today only one-half of the farm area in the United States is improved land, and only two-thirds of the improved land is in farm crops, including meadows. The other third of the improved land, and a considerable part of the unimproved land, are utilized as pasture for domestic animals.

(3) They make use of farm crops which would be wholly or partly wasted. For example, straw, corn-stalks, clover, alfalfa and many other leguminous forage crops would not have sufficient value to pay for raising, if animals were not kept to convert them into useful products.

(4) Animals act as machines for manufacturing raw materials which are coarse and bulky into finished products which are more concentrated and valuable. It takes ten pounds of dry matter to produce a pound of beef, and thirty pounds of dry matter to produce a pound of butter. The farmer not only has the profit which comes from the manufacturing of this thirty pounds of raw material into one pound of butter, but, while the butter may be sent a thousand miles to market, it might not be profitable to ship ten miles the products from which the butter is made.

(5) In manufacturing these finer products, animals leave much fertilizing material on the farm. In fattening animals the experiments of Lawes and Gilbert show conclusively that more than nine pounds out of every ten of the essential fertilizing ingredients of the food reappear in the solid and liquid excrement. A Flemish proverb reads:

"No grass, no cattle,
No cattle, no manure,
No manure, no crop";

or, as Prothero says, "Farming in a circle, unlike logic, is a productive process."

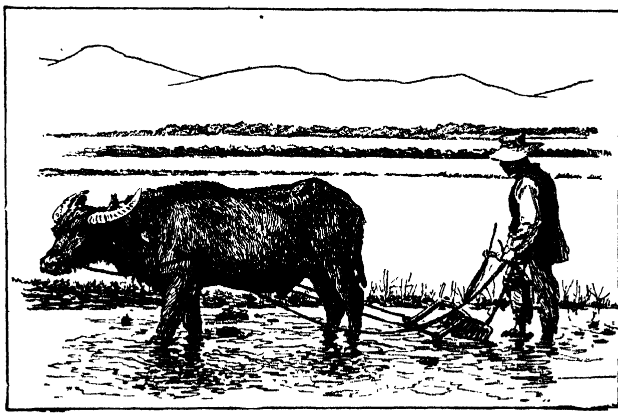


Fig. 13. Use of water-buffalo in plowing for rice. Philippines.

(6) Live-stock enables a farmer to arrange more readily a good rotation of crops. So far as maintaining the fertility of the land is concerned, and reducing the cost of production, a five-course rotation is better than a four-course, and a six-course is better than a five-course rotation. It enables the farmer to keep a larger proportion of his land in

grass and clover, thus requiring less plowing; it enables him to keep each piece of land longer in grass and thus reduce the exhaustion of his land, provided these products are fed to live-stock on the farm.

Fig. 14. Use of oxen in haying.

(7) Animals enable the farmer to make a more constant use of his capital. The wheat-farmer in North Dakota sows his wheat in April and May, and harvests and threshes it in July and August, and is practically without employment for himself, his men or his teams from September 1 to April 1. When live-stock is kept, the labor that is used in the summer to raise crops is needed in the winter to care for the animals. The teams and tools are also more constantly used.

(8) The management of live-stock and the manipulation of dairy products, and the rearing of poultry, may be made to require higher skill than the ordinary extensive production of farm crops. The product of skilled workmen always commands higher return than that of unskilled workmen. In this country the communities that have given the most attention to live-stock have in general been the most prosperous, although to this there are some exceptions.

(9) It is interesting to observe that with certain methods of farm management more land can be farmed with the same labor when live-stock is kept than when almost exclusively hay-and-grain-farming is practiced. This is the case when sheep are grazed over large areas, or when beef cattle are reared, especially young animals. The War of the Roses in England so reduced the laboring population of Great Britain as to cause a revolution in the agriculture of the island, the raising of live-stock taking the place of grain-farming. The land was enclosed, and, in consequence, the communal use of land largely, if not wholly disappeared. On the other hand, the keeping of live-stock may greatly increase the amount of labor required to manage a farm, especially when dairy cattle are kept, and when partial or complete soiling is practiced.

(b) *Disadvantages of keeping live-stock.*—(1) It requires large capital. This is especially true when animals are kept as usual in connection with the production of hay and grain. On a 160-acre farm, forty head of cattle, worth $1,500, forty head of sheep, worth $200, and twenty hogs, worth $100, may be kept and the farm made to raise the necessary food for them. This increases the capital required $1,800, as practically the same other capital would be required for the production of hay and grain. In addition to the capital for live-stock, usually more capital must be invested in farm buildings. In a self-contained farm, that is, one which raises food enough for the animals kept, ten dollars an acre may be considered a moderate investment for live-stock. If, however, the farm is to raise only the coarse feed and the necessary grain is largely purchased, a farm may easily carry twenty-five to thirty-five dollars' worth of live-stock per acre.

(2) This live-stock capital is of a perishable nature. Not only the products of a single year but all the capital may be destroyed by disease. Thus, not only may several crops be lost but also the capital invested in producing these crops, which has been the accumulation of years. Tuberculosis in cattle, cholera in hogs and liver rot in sheep are striking examples. Formerly, many farmers kept one hundred hogs where now they keep only twenty-five or fifty, because they dare not take the risk of disease.

(3) Products when grown cannot be indefinitely held. If held for a better market they must often be held at an expense. Cold storage and the preservation of meats have lessened this difficulty slightly, but there is still a great difference between animal products and the cereals, which can be held for long periods, either by the farmer or in great elevators of primary markets.

(4) A scarcity of food and consequent rise in

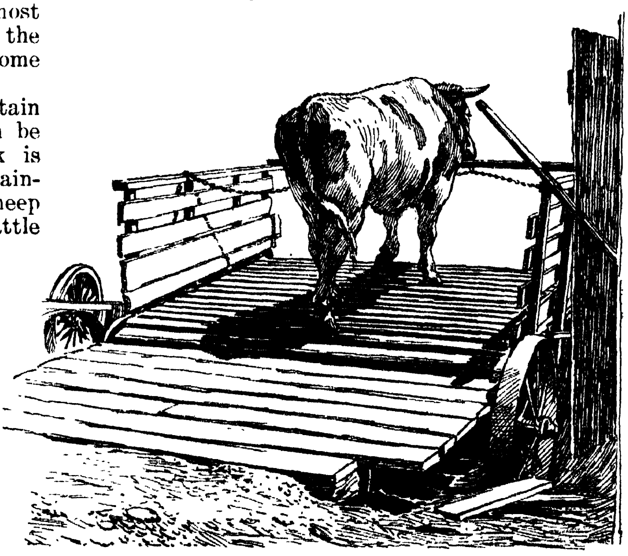


Fig. 15. A still frequent use of animals as motive power.

price of hay and grain may cause a loss instead of a gain from feeding. Many illustrations of this fact could be quoted. For example, in 1890 a decrease of about 30 per cent in the yield of grain caused an increase in the price of over 50 per cent, so that if the whole crop could have been sold it would have brought more than the crop of the previous year. Facts like these have frequently caused people to assert that, although society suffered, the farmers were benefited by a short crop. Fortunately, this is not the fact, because only about 20 per cent of the corn is sold by farmers, and when there was a decrease of 30 per cent many farmers not only had no corn to sell but they either had to purchase corn or use other crops, such as oats, which they would otherwise have sold.

weighing 125 to 250 pounds, followed three steers or heifers on a two-acre pasture. The cattle were fed shelled corn liberally but the pigs were given none. The pigs made a gain of a little more than a half pound per day, and when subsequently put on full feed made in one trial a gain of nearly seventeen pounds for one bushel of corn, while in general about eleven pounds of pork are produced from a bushel of shelled corn. Second, swine are noted for their prolificacy. Ten sows, worth \$100 to \$150, are sufficient to produce 100 pigs; 75 to 80 ewes, worth \$300 to \$500, will be required to produce an equal number of lambs; 110 cows, worth \$4,500 to \$5,500, to produce 100 calves; and 200 mares, worth \$20,000 to \$30,000, to produce 100 foals. To put it in another way, the capital invested in

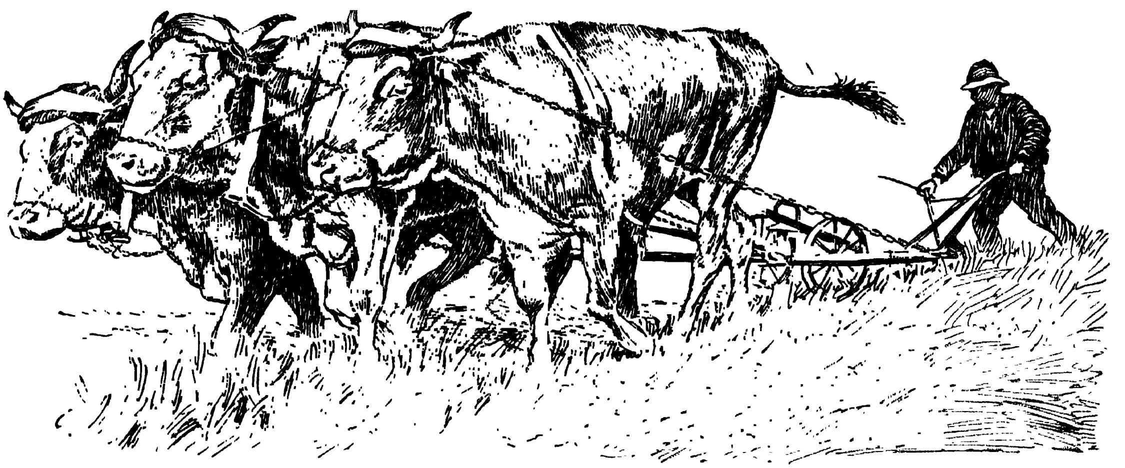


Fig. 16. Simmenthaler oxen. The best draft type of cattle.

(c) *Cost of producing live-stock.*—In estimating the amount of food required to carry live-stock through the year for the purpose of determining what part of a crop may be sold, twenty-five pounds of dry matter per day may be allowed for each thousand pounds of live-weight of horses, cattle and sheep, and forty pounds per thousand pounds of swine; or, in calculating the amount of food required for swine it may be more convenient to do so on the basis of the increase in live-weight, allowing five pounds of dry matter for each pound of increase.

Cost of producing hogs.—Pigs are unique in two particulars: (1) They are usually fed on concentrated foods only, and (2) they produce nothing but meat and fat. From cows we get milk, in addition, from sheep, wool, and from poultry, eggs. Because of this limited range of usefulness and because of the high value of much of the food consumed, it would not be possible economically to rear swine were it not for two characters which they possess. First, the pig is a scavenger. Many corn-fed cattle of the central West are fed without direct profit. The profit comes from the pigs which follow the cattle. In many other ways pigs use up products which would otherwise be wasted. In an experiment at the Illinois Station during two seasons, two pigs,

pigs may be reproduced in the offspring ten times in one year, the capital invested in horses perhaps once in five years. In general, 500 pounds of corn will produce 100 pounds of pork, which is equivalent to eleven pounds of pork from a bushel of corn. Since hogs are so largely produced from corn, the relation between the price of corn and the price of pork is very intimate. For example, when corn is worth fifty cents a bushel, the food required to produce a pound of increase will be about five cents; for forty cents a bushel, four cents; and for thirty cents a bushel, three cents; and so on.

Relative cost of producing sheep and swine.—In experiments at the Wisconsin Station it was found that the expense of producing a pound of increase in sheep was less than in swine because of the less expensive character of the food. It was also found that sheep required less food per pound of gain than steers. These agree with Lawes' and Gilbert's experiments, who found that eleven pounds of increase in sheep and nine pounds in steers were obtained for every 100 pounds of dry matter eaten.

Comparative cost of producing meat and milk.—American experiments show that 100 pounds of dry matter will produce ten pounds of increase in

steers, or, when fed to cows, seventy-four pounds of milk containing three and one-fourth pounds of butter-fat plus one pound of increase. In general, therefore, the food required to produce a pound of butter-fat is about three times that required to produce a pound of increase in steers. So far as food consumed is concerned, therefore, assuming it to be of equal quality, steers at five cents a pound would be equivalent to butter-fat at fifteen cents per pound. If butter-fat sells at thirty cents a pound, half the income may be charged to labor or profit. By selling butter-fat at thirty cents a pound instead of steers at five cents a pound, the gross income per acre of the farm may be doubled; or, what is perhaps more to the point, when animals are kept for the production of meat instead of the production of butter-fat the farm area should be doubled.

Fig. 17. Horseman with panniers, showing method of riding. Porto Rico.

Cost of producing milk and butter-fat. — Well-selected and properly fed grade cows may be expected to produce 240 pounds of butter-fat annually. This is equivalent to 8,000 pounds of 3 per cent milk, 6,000 pounds of 4 per cent milk, or a trifle less than 5,000 pounds of 5 per cent milk. If each cow is dry six weeks, the daily average of the herd in milk will be three-quarters of a pound of butter-fat per day. Occasional herds will make a daily average of .9 of a pound of fat, but this requires superior cattle, careful feeding and more than ordinary care. The standard ration for milch cows weighing 1,000 to 1,200 pounds is twenty-five pounds of dry matter, two-thirds of which is digestible material containing not less than two pounds of digestible protein. In ordinary practice, about ten pounds of dry material of the ration is secured from corn silage, nine pounds from hay and about six pounds from grain or other concentrates. In general, this is obtained by feeding thirty-five pounds of corn silage, ten pounds of hay and seven to eight pounds of concentrates. In general, the silage may be estimated at one-tenth of a cent a pound, hay at one-fourth to one-half a cent per pound and concentrates at three-quarters to one and a quarter cent per pound, although these prices will vary somewhat with the different sections of the country. The amount of food needed will vary with the size of the cow, although not in direct proportion to weight, and should be varied more largely in proportion to the milk and butter-fat produced. Careful feeders vary the amount of concentrates fed to the individual animals in the herd, although maintaining substantially the general averages given above.

Cost of maintaining work horses. — The cost of maintaining work horses depends both on the size of the horses and on the work done. Since the work capable of being done varies greatly with horses of different size, and since the work which horses of the same size are called on to do often varies greatly, the amount of food consumed is perhaps more variable than that of any other class of domestic animals. In general, horses weighing 1,200 to 1,500 pounds consume twelve to eighteen pounds of grain, ten to twenty pounds of hay at full work and half the amount of grain when idle. The expense of each day's labor depends not alone on yearly expense but on the number of days of labor. At the Ohio State University, a record was kept in order to determine the number of days of labor performed, as well as the cost of food consumed and other expenses. It was found that four draft-horses, averaging a little less than 1,400 pounds each, performed 2,185 hours of labor per year, and that four horses weighing 1,225 pounds averaged 1,641 hours. The average work done for the horses was thus about 200 days per horse, equivalent to two-thirds of the secular days of the year or about six and two-thirds hours per day for each secular day of the year. Taking no account of three colts, one two-year old and two sucklings, the average cost of care, including feeding, grooming, harnessing and cleaning stables was $23.50. The cost of shoeing, repairs on harness and stable supplies was $6.50, and the cost of food $54, making the average total expense of keeping each horse $84 per year, not counting interest on the investment of stables, horses or harness, nor anything for depreciation of horses through age. It is possible that under ordinary conditions the growth of the three colts may more than cover the latter point. As each horse worked approximately 200 days per year, the average cost of each day's work was a trifle less than 42 cents. At the Minnesota Station, the total cost of feeding and maintaining a farm work horse for one year, including interest on investment and depreciation, was estimated to be $75 to $90, of which about $20 was charged for interest and depreciation. On the basis of 3.3 hours for the length of the working day, the cost per horse per hour was estimated at seven and a half cents.

Literature.

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CHAPTER II

PHYSIOLOGY OF THE ANIMAL

PHYSIOLOGY IS THE SCIENCE OF THE PROCESSES OF LIFE. A knowledge of it underlies all rational treatment of animals and plants. Very little fundamental knowledge of physiological laws and phenomena has been available to the farmer, and he has been greatly handicapped thereby. Lacking this foundation and a point of view, his attempts to explain what he has seen have too often followed his prejudices and the traditions that have come down to him.

It is not necessary that the layman's knowledge of physiology be deep, but it should be rational: that is, whether much or little, it should be founded on fact and be true as far as it goes, his mind should be free of prejudice, and his point of view should be correct. But in order that the public point of view may be rational, somebody must delve for the fundamental facts. We are greatly in need of a recognized body of leaders in these matters, who shall shape public opinion. There are already many such men, but not enough as yet to fertilize the agricultural mind. The farmers are willing to learn and to accept sound doctrine.

The necessity, therefore, is for a more liberal organization and support of chairs and institutions that shall be devoted to research into the central facts of physiology, as well of plants as of animals. The study of animal physiology is involved in special difficulties because of the fact that animals are what may be regarded as personalities and because experimental physiology demands large numbers of animals and extensive quarters. Physiology is not merely the study of the vital processes within the animal body, as text-books would lead us to think: it is quite as much a study of the whole life relation. Life processes express themselves in welfare. This welfare is the result not only of alimentation and reproduction, and the processes of the internal organs; it results also from the whole relation or reaction of the animal to heat and cold, to altitude, to contest with fellows and to the habits of life that are imposed upon it. Ecology, or the study of habits and seasons of animals and plants, is properly a department of physiology. All good artificial breeding must proceed on a knowledge of physiological laws.

It will be seen, therefore, that the study of physiology has a broader significance than merely to enable us to understand the nature and treatment of disease. Veterinary instruction, as ordinarily conceived, covers chiefly the pathological phases of physiology, much as the instruction in human medicine has looked to the treatment of disease more than to the preservation of health. Veterinary colleges range themselves with medical colleges rather than with agricultural colleges, and their chief purpose seems to have been to turn out practitioners. This is well, but veterinary practice is of right only a means to an end: the end is the welfare of the animal industries.

It is to be expected that the association of veterinary colleges in the future will be with colleges of agriculture as well as with colleges of medicine. In fact, this association is already working itself out in the veterinary departments of colleges of agriculture; these departments may not train veterinary practitioners, but they align their subject directly with agricultural welfare. It is certainly worth while to give all agricultural students a point of view on animal health and disease and to instruct them in the methods of handling common ailments and accidents, although there are those who fear that all knowledge of this kind, short of a degree in veterinary medicine or its equivalent, is dangerous. It is a fact that most stockmen will handle a certain part of the treatment of their animals themselves anyhow, and it is better that they have some instruction. It is due all stockmen that they be afforded the opportunity to receive instruction that will enable them to handle their herds; and it is not true that partial training is worse than no training. All training, even the best, is partial or fragmentary.

On the other hand, there has never been so great need as now for well-trained professional veterinaries. The animal husbandries are expanding; intercommunication is spreading parasites and diseases; the value of individual animals is increasing; the relations of live-stock to public health are being understood; governmental regulation is extending. A few colleges have set the mark for very high attainments in the veterinary profession, and this idea should spread. The training of the veterinary physician should be every bit as good as that of other physicians and should be enforced by equally rigid statutes. The endowments of these schools or colleges of veterinary science need to be much increased. The office of the well-educated veterinarian is only beginning to be appreciated. He will exert great influence on public health and on agriculture.

The point is that all farmers should be put in touch with the real facts in regard to the main physiological laws and phenomena, that a person can be of great service to himself by knowing something of the treatment of his herds, and that there should be over all a larger body than now of highly trained veterinary physicians. There is need that the formal etiquette of the medical profession do not handicap the welfare work of a good veterinary practitioner by forcing him into mere professionalism, nor of a good veterinary college by preventing it from engaging in some kinds of extension work. The veterinary profession needs to range itself very closely with agriculture, rather than too closely with medicine, if it is to accomplish the greatest good for the people. The profession will grow in power in proportion as it aids directly in the development of the live-stock interests, not only in subjects of disease but also of sanitation and in its influence in developing the right conditions under which animals may be reared. From the point of view of the state, animal physiology and pathology are primarily agricultural subjects.

If these various results are to be secured, it follows that instruction in physiology should begin long before the student enters college. The point of view on physiology should be established in earliest youth, inasmuch as the first concern of every person is to live; and but very few persons have the opportunity of going to college. The very general lack of any sound understanding of the commonest physiological laws is evidenced in the wide extent of the medicine habit. If only a bottle has a reassuring label, persons will immediately deposit the contents in their stomachs without the least knowledge of what the stuff contains and in the sublimest faith in its possibilities. This is a most astonishing mental attitude, but so common that we do not challenge it. It is astonishing that we should consider a medicine to be a sufficient antidote or corrective to the plain faults of the daily living. [Consult the editorial on pages 278, 279, in Vol. I.]

The ordinary school teaching of physiology is not likely to put a pupil into real touch with the common necessities of his daily life: it is likely to be a reflection of the physician's anatomy and physiology. The teaching of physiology that is enforced by organizations, whereby great emphasis is placed on the injuries of certain substances, is likely to be partisan, and to that extent is pedagogically unsound. All partisanship should be eliminated from school teaching: science is impartial. The fact is, that knowledge of physiology should be the natural result of the teaching of plants and animals. The farm youth should have a distinct advantage here, for his whole experience is an experiment in making animals and plants to thrive. We have been teaching fragmentary views of "botany" and "zoölogy," but we should teach animals and plants in such a way that the pupil shall have a real conception of the processes of life. When the farmer once realizes that his daily experience with his live-stock may constitute a real study in physiology, he ought to arrive at a new point of view on the means of studying himself and of caring for his body.

If a person once gains an understanding of the underlying laws of physiology, his common practice with his animals will be rational. He will see, for example, that bovine tuberculosis is not occult and is not a matter of course or of chance. There are certain conditions that make it possible for the disease to spread, and these conditions can be overcome. He will see, then, that the mere slaughtering of all tuberculous animals will not stop the disease, any more than the death of all patients in a tropical seaport will annihilate yellow fever. All the conditions and circumstances under which the animals are kept must be made sanitary, and the elimination of the disease will proceed with the increase in care. This care will include the destruction of animals that are dangerously diseased, the control of commerce in infected animals, and the isolation of infected and suspicious cases. The control of tuberculosis, as of other diseases, is a question of rational popular education rather than of statutes.

PHYSIOLOGY OF DOMESTIC ANIMALS

By *S. J. J. Harger*

The exploitation of live-stock is one of the great sources of national wealth. By means of special precautions by the breeder in selecting and mating animals, economic feeding and farming, good hygiene and proper surroundings, the domestic breeds have been much improved. To act on the animal organism so as to increase its productiveness, develop special qualities and create new breeds, requires some knowledge of the natural functions of the body.

Digestion.

The animal body is constantly excreting certain waste products representing wear and tear. To maintain the nutritive balance, this expenditure must be replaced by nutrients elaborated from the food. The principal nutritive ingredients in all food-stuffs are proteids,—represented by albumen and its derivatives,—starches and sugars, cellulose in the diet of herbivora, and fats. These must undergo certain transformations for absorption and assimilation.

Preparation of food. Mouth digestion. Mastication.—Mastication is performed principally by the molar teeth or grinders, the jaws being moved by powerful muscles. The surface of the grinders is flat and roughened. The jaws in herbivora move from side to side. The food is chewed on only one set of lateral grinders at a time, and this may continue in the horse for an hour. When the muscles become tired the action is reversed. Unilateral mastication is possible because the upper jaw is wider than the lower and the apposition of the teeth such that the inner edge of the upper and the outer edge of the lower molars are worn most. Thus, the external and internal borders of the molars, respectively, become long and sharp and may require filing or "floating." A horse requires two and one-half hours to chew ten pounds of hay, the jaws moving eighty times per minute; one pound of hay makes sixty-five boluses. In the pig, dog and cat, mastication is chopping; the teeth overlap and a perfect hinge-joint unites the lower jaw to the skull. Mastication mixes the food and saliva, facilitates swallowing and, by crushing the hard envelopes of the food particles, prepares them for action of digestive juices. Hay absorbs four times its weight of saliva, and oats an equal weight.

Swallowing.—In swallowing or deglutition, the tongue forces the bolus into the back part of the mouth and squirts it into the pharynx. Here it is grasped by the constrictor muscles and passed into the esophagus or gullet. Its downward course can be seen best in the left side of the neck.

The food cannot pass into the larynx and windpipe for the following reasons: Muscles close the opening (glottis) of the larynx by adducting the vocal cords and arytenoid cartilages, breathing and swallowing at the same time being impossible; the base of the tongue pushes the epiglottis, like a lid, over the opening; certain muscles pull the larynx forward under the tongue. The muscle movements of swallowing are controlled by a swallowing center in the brain. The pharynx of the ox, sheep and goat is very capacious and very large objects can be swallowed.

Saliva.—The saliva is a watery opalescent fluid secreted by three principal salivary glands,—the parotid on the side of the throat below the ear, the submaxillary and the sublingual between the branches of the lower jaw. These discharge their secretion into the mouth by special ducts. In the horse 84 and in the ox 112 pounds are secreted in twenty-four hours (M. Smith).

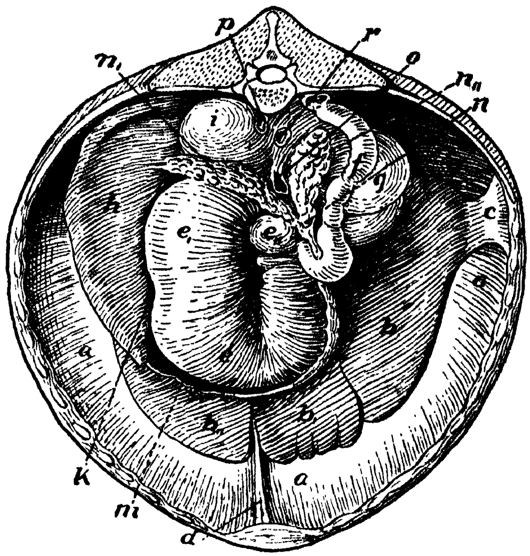


Fig. 18. Transverse section through body of horse, as seen from behind. *a*, Abdominal surface of the diaphragm; b, b_1, b_2, lobes of the liver; *c*, right broad ligament; *d*, round ligament; *e*, glandular part of stomach; e_1, non-glandular part of stomach, "blind sac"; e_2, pylorus; *f*, duodenum; *g*, right kidney; *h*, spleen; *i*, left kidney; *k*, splenic ligament; *m*, cut edge of splenic ligament; *n*, pancreas; n_1, left pancreatic lobe; n_2, right pancreatic lobe; *o*, portal vein; *p*, aorta; *r*, inferior vena cava.

The saliva assists (1) in swallowing. (2) It contains a soluble ferment (ptyalin) that converts the starch of the food into sugar (maltose) and, in the horse, converts cane-sugar into grape-sugar (glucose). This amylolytic action, beginning in the mouth, is continued in the stomach until arrested by the hydrochloric-acid acidity of this organ. The salivas of the pig, dog, sheep, horse and ox possess this property in the order named. (Ellenberger). When the saliva is diverted, swallowing is difficult and the animal loses flesh.

Stomach digestion.—The stomach of the horse has a capacity of twelve to fifteen quarts. In the left compartment (cardia), the mucous lining is non-secretory; in the right (pyloric) side it is velvety, reddish, and has numerous glands to secrete gastric juice. The gastric juice contains pepsin,—a soluble ferment,—free hydrochloric acid (.02 per cent), rennin and lactic acid.

Pepsin, in the presence of free acid, converts the proteids of the food into absorbable peptones. In the left compartment the saliva continues to

act for several hours on starch. Ellenberger and Hofmeister hold that starch conversion takes place in the stomach through the development of ferments from the food itself. Oats yields such an enzyme; it is destroyed by boiling. These facts help to explain the universal use of oats as a food and its lessened digestibility when boiled.

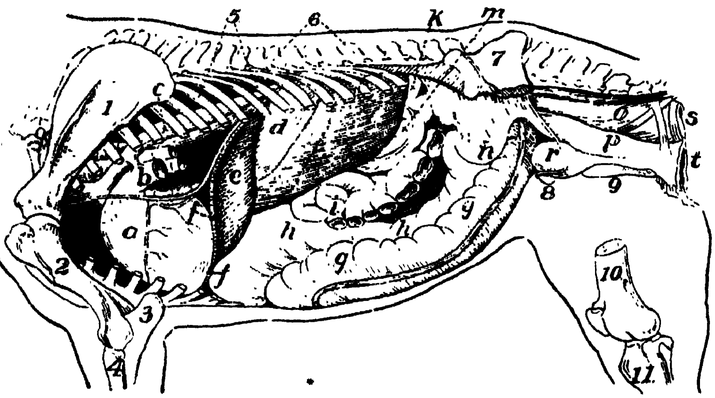


Fig. 19. Side view of internal organs of mare. 1, Scapula; 2, humerus; 3, ulna; 4, radius; 5, ribs; 6, vertebral column; 7, ilium; 8, pubis; 9, ischium; 10, femur; 11, tibia; *a*, heart; *b*, pulmonary artery; *c*, aorta; *d*, stomach; *e*, liver; *f*, cut edge of diaphragm; *gg*, *hh*, large colon; *i*, small intestine; *k*, kidney; *m*, small colon; *n*, uterus; *o*, rectum; *p*, vagina; *r*, urocyst or bladder; *s*, anus, *t*, vulva.

The duration of stomach digestion varies. A hay ration requires six to eight hours; one of oats, five to six hours. When no other food is given, the stomach empties itself in fifteen to twenty-four hours. A sudden change of diet retards digestion and thus predisposes to indigestion and fermentation. The food undergoes a sort of churning motion and becomes mixed toward the pylorus. After entering the left sac it is rapidly forced to the right side and its passage into the small intestine, regulated by a constrictor or sphincter muscle around this orifice, is rapid at the beginning of feeding and then slows until the stomach is about two-thirds filled. In this state, digestion is most active; over-distension arrests it. After this period the outgo equals the income until digestion is completed.

The stomach, being small, empties itself two or three times during a meal. Different foods leave the stomach successively in the order fed. Hence, since proteid digestion is the principal function of the gastric juice, proteid concentrates, as oats, should be given after the hay to secure the benefit of prolonged stomach digestion. The incorrect practice of giving grain first is partly mitigated by some hay remaining in the stomach from the previous meal and retarding the passage of the grain into the intestine. Water may pass into the intestine two minutes after drinking, and carries with it some undigested food. Horses should be watered before feeding.

The stomach of the ox is divided into four compartments: (1) The rumen or paunch, holding 40 to 60 gallons or nine-tenths of the total stomach capacity, occupies the major part of the abdominal cavity. Its mucous lining is covered with long leaf-like eminences and always peels off immediately after death. (2) The reticulum, honeycomb or water-bag has its mucous surface arranged in large honeycomb-like spaces. The contents are liquid and often contain foreign bodies—nails, wire, stones and the like,—which may penetrate through the diaphragm into the chest cavity and cause traumatic pericarditis, or "nail in the heart." The reticulum in its interior shows the esophageal groove. This is an inverted gutter with thick borders extending from the gullet to the third stomach. The muscular arrangement is such that during its contraction the gutter forms a canal to convey food from the gullet into the manyplies without dropping into the paunch or the honeycomb. (3) The third stomach, omasum or manyplies, has numerous large, flat, fleshy leaves projecting from the inner wall and studded with pointed horny eminences. (4) The abomasum is the true digestive stomach. The arrangement of the stomach of the sheep and of the goat is almost identical.

In the rumen the action of the saliva is continued, and 60 to 70 per cent of the cellulose is digested. In the third stomach the food is further triturated by the fleshy leaves, and the liquid parts squeezed out into the abomasum. The contents are always hard and dry. In the abomasum proteids are converted into peptones.

The stomach of the pig is of a type between that of ruminants and carnivora. The digestive secretion contains pepsin, hydrochloric acid, lactic acid, milk-curdling and starch-converting ferments. The stomach of the dog is capacious. The digestive juice is very strong, although dogs have lived for four years after removal of the stomach. It contains pepsin, more hydrochloric acid (1.7 per cent) than in other species, and is four times as strong as that of sheep. Twelve hours are required to digest a full meal of meat. Meat and liver are most digestible when fed raw.

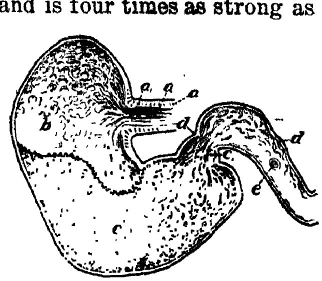


Fig. 20. Section through stomach of horse. *a a a*, End of esophagus, showing muscular wall and mucosa; *b*, non-glandular mucosa (fore-stomach); *c*, the villous mucosa or true digestive part; c_1, pyloric orifice; *d*, duodenum; *e*, orifices of bile and pancreatic ducts.

Rumination.—Cud-chewing animals or ruminants include, among others, the ox, sheep, goat and camel. Food is partly masticated and enters the paunch. It must be returned to the mouth for a further chewing. This is called rumination. Finely divided semi-solid food may pass into the third stomach through the esophageal groove without rechewing. Liquids pass into all four compartments, but the greater part enters the paunch.

The mechanism of rumination is as follows: A churning movement by the paunch forces the contents toward the orifice of the gullet. A deep inspiration followed by compression of the paunch by the diaphragm and the abdominal muscles forces the macerated contents of the paunch into the funnel-shaped orifice of the gullet, which cuts off a bolus and by reverse peristalsis conveys it into the mouth. The water-bag (second stomach) also shares in this contraction and supplies water to saturate the mass. After swallowing the second time, the bolus either passes into the rumen again or reaches the third stomach through the esophageal gutter. The formation of the bolus and its ascent require three seconds, mastication fifty seconds and the descent one and one-half seconds. A given amount of water in the rumen and a certain degree of distention are necessary. After a meal cattle may not begin to ruminate unless watered. At least seven out of twenty-four hours are given to rumination. It is a voluntary act. "Losing the cud" is a myth. During sickness rumination ceases; when the appetite returns the cud returns of its own accord. This imaginary disease belongs to the same category as the "hollow horn" and "wolf in the tail." All horned cattle, excepting the very young, normally have hollow horns.

Vomiting.—Vomiting is a reflex act caused by stimulation of the vomiting center in the brain, inducing spasmodic contraction of the stomach, diaphragm and abdominal muscles. The pig, dog and cat vomit readily; it is nature's method of relief. Cattle vomit infrequently, and horses only in extreme circumstances for the following reasons: (1) The esophagus, where it enters the stomach, has a thick and contracted wall. (2) There are spiral muscular fibers in its wall at this point. A stomach inflated artificially with gas through the small intestine will rupture under compression before leaking through the esophagus. The inability of the horse to belch makes acute indigestion with bloating of the stomach very dangerous. (3) Close to the constricted orifice of the esophagus is the relaxed intestinal opening, giving exit to the contents under compression. (4) The stomach is not in contact with the abdominal wall. Vomition in the horse nearly always causes a ruptured stomach and is fatal. In horses and cattle the vomiting center seems to be insensitive to nauseating drugs.

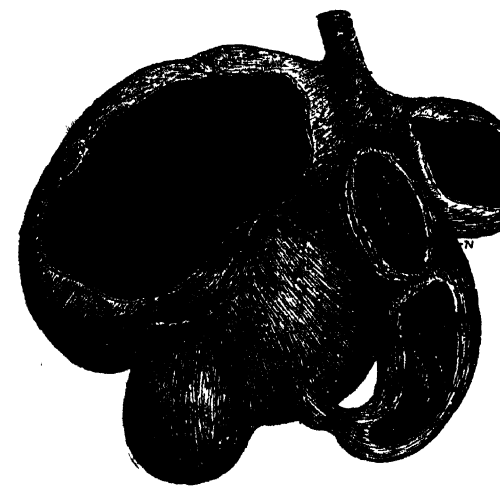


Fig. 21. The stomach of a sheep.

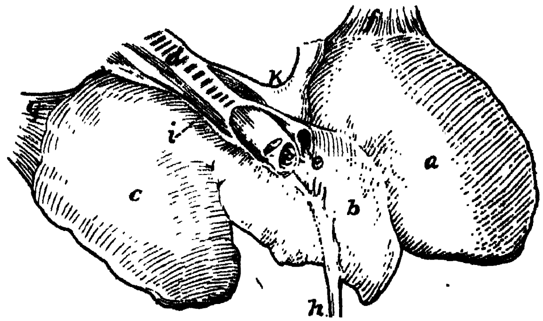


Fig. 22. Liver of horse. *a*, Left lobe; *b*, left part of middle lobe; *c*, right lobe; *d*, vena cava inferior; *ee*, hepatic veins; *f*, left broad ligament; *g*, right broad ligament; *h*, round ligament; *i*, coronary ligament; *k*, esophageal fissure or notch.

Intestinal digestion.—The contents of the stomach on entering the small intestine constitutes chyme. Here it is acted on by three digestive secretions—the intestinal and pancreatic juices and the bile. The intestinal juice (succus entericus) is secreted by numerous small glands in the mucous lining of the large and small gut. It contains three ferments: Proteids are converted into peptones, starch into sugar, cane-sugar into grape-sugar and, according to some, maltose into dextrose. A vermicular movement (peristalsis) rapidly forces the contents into the cæcum; considerable liquid is absorbed and the gut is never found in a state of repletion.

The liver is a large gland weighing in the horse eleven pounds. A large blood-vessel (portal vein) returns from the digestive tract and carries to the liver sugar, peptones and certain products of intestinal decomposition to be elaborated for the nutrition of the tissues. The functions of the liver are: (1) Secretion of the bile. The bile is a yellowish green liquid conveyed by the bile duct into the small intestine. In the horse nine ounces and in the ox four ounces are secreted per hour. Its main solid constituents are coloring matter or pigment (bilirubin and bilivirdin), bile acids (glycocholic and taurocholic) and salts (glycocholate and taurocholate of soda). The bile emulsifies fats for absorption. Fatty acids develop in the intestine from fermentation; these unite with the sodium salts to form soaps, which emulsify the fats. When the bile duct is ligated, fat absorption is reduced 50 per cent and the stools become "clayey." Bile also acts as a natural laxative or aperient.

(2) The liver has an emunctory function. Intestinal putrefaction of proteids develops certain toxic products. These, when conveyed to the liver, are there converted into benign compounds, as urea, excreted through the kidneys. The liver also converts the muscle break-down (creatin) into urea and uric acid. After obstruction of the bile duct,

the coloring matter is absorbed by the blood-vessels and we have biliary jaundice. The bile acids also are toxic; when formed in excessive quantity and absorbed as free acids they cause hepatic toxemia or poisoning. Most of the solids of the bile represent waste products.

(3) The glycogenetic function of the liver is, in a word, as follows: The sugar conveyed from the intestines to the liver is by a special function of the liver cells converted into a form of animal starch called glycogen and stored up here as a surplus nutrient to be called on by the body as needed. Then it is reconverted into sugar and as such enters the circulation. Thus, besides its intimate association with the digestion of foods, the neutralization of, and elimination from the body of waste materials, the liver plays an important part in nutrition.

The pancreas, called the abdominal sweetbread, is a gland weighing two pounds, placed against the backbone close to the kidneys. It secretes a clear fluid called the pancreatic juice. In the horse and ox, seven to nine ounces are secreted per hour. This secretion contains three digestive ferments: (1) Trypsin, converting proteids into peptones; (2) amylopsin, changing starch into sugar; (3) steapsin, splitting up fats into fatty acids and glycerine, the fatty acids emulsifying fats in the same way as in the case of the bile.

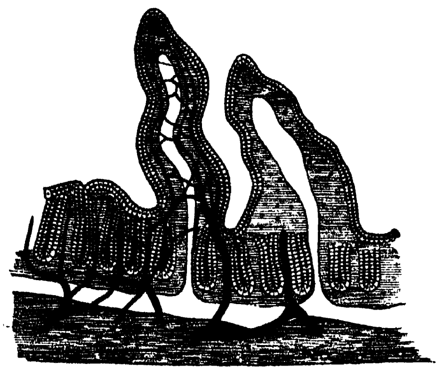


Fig. 23. Surface of mucous membrane of the intestine. Showing villi with central lacteal duct and blood vessels, and on the surface the absorbing epithelial cells.

Removal of the pancreas from the body is followed by diabetes or sugar in the urine, emaciation and death. The blood will not hold more than .3 per cent of sugar without excreting it in the urine. From this it is surmised that the pancreas secretes a sugar-destroying ferment.

The large intestine comprises the cæcum and the large and small colon. The cæcum or blind gut of the horse lies in the right flank, is about three feet long and blind at its anterior end. The opposite end has the two openings for the entrance and exit of the food, which in passing out is moved against gravity. It is capacious and compensates for the smallness of the stomach. The contents are soft.

The large or folded colon has six times the capacity of the stomach. Its contents are firmer than those of the cæcum. It terminates in the horse in the small colon by an abrupt narrowing, where frequently impactions take place. It is thought by some that in the cæcum and colon, fat, starch and proteids are acted on by various species of bacteria. Cellulose in particular is digested here and large quantities of water are absorbed. Water rapidly passes from the stomach into the cæcum, which is also thought to act as a receptacle for water for the needs of the body. The food remains in the colon about forty-eight hours.

In the small colon the ingesta lose their water, become drier as they approach the rectum and are moulded into balls by its sacculated wall. An animal may be nourished through the rectum and colon, or narcosis can be produced by drugs.

In the ox, the rumen partly takes the place of the cæcum and colon of the horse. In the small intestine absorption is most active. The ox digests more cellulose than the horse, and can thrive better on coarse, woody forages.

In the pig, intestinal digestion is of short duration. The same is true of the dog, whose intestines are relatively short.

The character of the feces varies with the species. Their softness depends on the moisture in the food and the movements of the bowels and not on the quantity of water drank. The horse defecates ten to twelve times in twenty-four hours. and more during the night than during the day. It requires in the horse ninety-six hours and in the ox seventy-two hours for the food to pass through the body; in the goat as much as seven days for some foods. In the horse and ox, 40 per cent of the nutrients of the food are lost in the feces; in the dog, only 2 per cent.

Circulation of the blood.

The heart is the propelling organ in the circulation of the blood. In circulation, it distributes nutrient matter throughout the body and collects waste materials to be excreted by the lungs, kidneys and skin. The blood cycle is as follows: The blood leaves the left side of the heart (left ventricle) as red or arterial blood, and passes through the arteries and capillaries. Here it gives off nutrients to nourish the tissues as well as oxygen for oxidation, especially in the muscles, in order to produce heat and energy. It also takes up carbonic acid gas and other waste products. It is now venous blood and reaches the right side of the heart (right ventricle) through two large veins,—anterior and posterior vena cava. From the right ventricle the blood passes through the pulmonary artery to the lungs, where it is oxidized into arterial blood that reaches the left side of the heart again through the pulmonary veins. Every beat of the heart is accompanied by two sounds separated by a short interval. These can be heard very distinctly on the left side behind the shoulder. They furnish valuable information as to the state of health and disease of the cardiac apparatus.

The blood from a vein is blue-red and flows in a continuous stream; that from an artery is light red and escapes in intermittent streams corre-

sponding to the heart-beats. Venous hemorrhage is more easily arrested than arterial. The velocity of the blood varies at different points; the farther away from the heart the slower the current: hence the legs, the parts farthest from the heart, become "stocked" when this organ becomes weakened and the blood vessels relaxed. The velocity is greatest in the large arteries and veins,—12 to 16 inches per second in the carotid artery, and 8.85 inches in the jugular vein. A complete cycle is made in the horse in 31.5 seconds, and in the dog in 16.7.

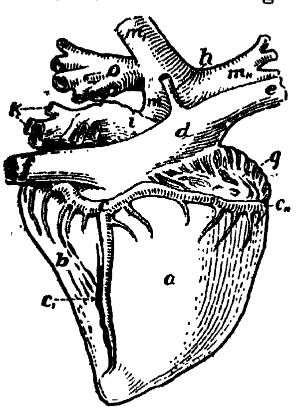


Fig. 24. Heart of the horse. *a*, Right lateral wall of the heart; *b*, left side of the heart; *c*, coronary artery; c_1, descending branch; c_2, right branch; *d*, *e*, superior vena cava; *d*, terminal part; *f*, inferior vena cava; *g*, appendage of right auricle; *h*, azygous vein; *i*, left auricle; *k*, pulmonary veins; *m*, stem of the aorta; m_1, descending aorta; m_2, ascending aorta; *o*, pulmonary artery.

The pulse is a dilatation of the elastic wall of an artery at the moment of the heart-beat. Its character is some indication of the state of health. It is felt in the horse on the lower jaw-bone; in the ox on the jaw, the inside of the elbow and cannon and the base of the tail; in the dog on the inside of the thigh. The number per minute varies: Horse, 36 to 40; ox, 45 to 50; sheep and pig, 70 to 80; dog, 90 to 100; camel, 28 to 32; elephant, 25 to 28. It is slower in the male than in the female. It is more rapid in the young than in the old, as, for example, in the foal, 100 to 120; in the calf, 90 to 130. The daily work of the heart is estimated at 1,539, 000 foot-pounds, or one-third of a horse-power.

The normal temperature of animals varies: Horse, 100° Fahr.; ox, 101 to 102.5; sheep and swine, 103; dog, 102.5 and very changeable. It is lowest about 4 a. m., and highest at 6 p. m. The liver, of all the organs, has the highest temperature, 106.2° Fahr.

The amount of blood in the body varies considerably: In the horse, $\frac{1}{15}$ (6.6 per cent); ox, $\frac{1}{13}$ (7.7 per per cent); sheep, $\frac{1}{12}$ (8.01 per cent); pig, $\frac{1}{22}$ (4.6 per cent); dog, $\frac{1}{18}$ to $\frac{1}{12}$ (5.5–9.1 per cent) (Sussdorf). An average horse has about 66 pounds, or nearly 50 pints of blood. In bleeding horses, about one pint of blood for every hundred pounds of body weight is removed.

The principal formed elements in the blood are the red and the white blood-cells or corpuscles, in the proportion of 1 red to 800 white. The red cells have a diameter of $\frac{1}{10000}$ to $\frac{1}{5000}$ of an inch. One cubic centimeter (16 drops) contains 7,000,000 to 8,000,000 red cells. They contain a red coloring matter called hemaglobin, essential to respiration. The white cells are larger than the red. They destroy bacteria in the blood and in this way protect the body against germ diseases.

Respiration.

Respiration comprises two distinct acts—inspiration and expiration. Inspiration or inhaling of air is a purely muscular act. Contraction and descent of the diaphragm increases the antro-posterior depth of the chest by four to five inches. The forward rotation of the ribs widens the chest laterally; only the last twelve or thirteen ribs participate in this action in the horse, and the saddle should never be so fitted as to interfere with their movements. The pleural cavity, or the space between the lungs and the chest wall, having a negative pressure, the inspiratory movements create a vacuum in this space, which, as it were, sucks in the air and dilates the lungs in a mechanical manner. In forced inspiration other muscles are called into play.

Expiration is largely mechanical. The inspiratory muscles suddenly relax, the chest walls collapse, the abdominal muscles bulged out during inspiration contract, compress the abdominal organs and force the diaphragm up into the chest cavity. All this tends to expel the air from the lungs by compression. The elasticity of the lungs also plays an important rôle. The air-sacs or vesicles have elastic walls and act like a rubber bag inflated by blowing air into it; when distended it will recoil and expel the air. At repose the expiration in the horse is longer than the inspiration, and is continuous. In chronic diseases of the lungs, such as heaves, in which the air-sacs are permanently dilated or ruptured and therefore not amenable to treatment, the expiratory movement of the flank has a double jerk. The fetal lung contains no air and sinks in water. This fact indicates whether a fetus was born dead or alive.

The number of respirations per minute are: Horse, 8 to 10; ox, 12 to 15; sheep and goat, 12 to 20; dog, 15 to 20; pig, 10 to 15. They are controlled automatically by the respiratory center in the medulla of the brain. They increase rapidly during exercise.

The respiratory changes in the blood consist principally in the interchange of oxygen and carbon dioxid. Atmospheric air contains by volume 20.96 per cent of oxygen, 79.01 per cent of nitrogen, .03 per cent of carbon dioxid and a small amount of moisture (Smith). The interchange of gases between the pulmonary air-sacs and the blood-vessels is based on the law of the diffusion of gases. The pressure of the oxygen in the lungs is higher than that in the capillaries; the pressure of the carbon dioxid in the lungs is lower than that in the capillaries. The gases will diffuse until the pressure on both sides is equalized. Carbon dioxid passes from the blood into the air-sacs, and oxygen from the air-sacs into the blood. Oxygen forms a weak combination with the hemaglobin of the red blood-cell, called oxyhemaglobin. No free oxygen is found in the muscles. It forms a new combination from which it is liberated as needed. The carbon dioxid taken up from the tissues converts hemaglobin into reduced hemaglobin. Some carbon dioxid is fixed in the blood by the sodium carbonate. The lungs also give off free nitrogen and other organic products that render the expired air impure and unfit for respiration.

The lungs of the horse contain about one and one-half cubic feet of air. During repose, between eighty and ninety cubic feet are inhaled per hour; three and one-half cubic feet of oxygen are absorbed and three cubic feet of carbon dioxid exhaled. The volume of the expired air, however, is greater than that of the inspired because of its expansion by the heat of the lungs. An average inspiration represents about 250 cubic inches or one-tenth of the total lung capacity. The lungs are never entirely emptied during expiration. A certain amount, called residual air, always remains.

These phenomena are rapidly increased by muscular exercise. Training in the horse is based largely on the amount of blood pumped into the lungs by the heart and that going from the lungs back into the heart. If more blood is pumped into the lungs than leaves it in a given time, congestion and breathlessness result and the animal becomes "choked."

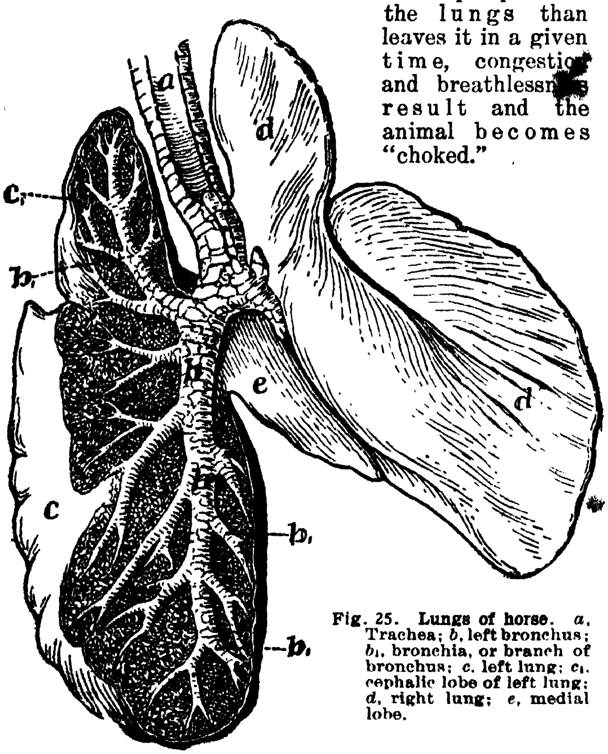


Fig. 25. Lungs of horse. *a*, Trachea; *b*, left bronchus; b_1, bronchia, or branch of bronchus; *c*, left lung; c_1, cephalic lobe of left lung; *d*, right lung; *e*, medial lobe.

In the nose and the facial sinuses,—large cavities within the sides of the face,—the air is warmed, receives moisture and loses dust particles. The absence of these changes explains the unsatisfactory results obtained from the use of permanent tubes in the windpipe. In a horse full of spirit a peculiar vibrating or "flopping" noise is sometimes made by the nostrils. It is not an unsoundness. The horse and ox do not breathe through the mouth except when in great distress; the soft palate is so large and pendulous that it practically closes the opening between the mouth and the throat.

The larynx, the organ of voice, is composed of five articulated cartilages surrounded and moved by muscles. In its interior it has a V-shaped passage, called the glottis, prolonged by the windpipe, though much smaller. The to and fro movements of the membranous vocal cords and the arytenoid cartilages widen the glottic opening during inspiration and narrow it during expiration. Vibration of the vocal cords produces the voice. Degeneration of the left inferior laryngeal nerve often causes an atrophy of the muscles on that side. This immobilizes the corresponding vocal cord and the arytenoid cartilage, and the air rushing through the insufficiently dilated glottis produces in the horse a sound called "roaring" or "broken-wind."

In the ox, sheep and goat the nostrils are small and immobile. The respiratory organs are less active, less adapted for muscular exercise and not so susceptible to disease as those of the horse.

The urine.

The kidneys are like a filter in removing from the blood noxious materials. Urine has a specific gravity of 1015 to 1036, is turbid, and yellow or yellowish red in color, due to broken-down blood pigment. It contains urea, uric and hippuric acids, creatin and creatinin; also sodium, potassium, calcium and magnesium combined with chlorine, oxalic, sulfuric, phosphoric and carbonic acids. In meat-eating animals the urine is acid. Uric acid only is found; it exists as urates. Where it is formed is not known. In herbivora the urine is alkaline, and hippuric acid replaces the uric acid. Hippuric acid, existing as hippurates of lime and potash, is derived from the benzoic acid of plants combined with glycin from albumen decomposition.

The organic group of urine constituents represents the nitrogen combustion. The more albumen in the food, as in carnivora, the more the urea. Urea itself is not found in the muscles. It exists here as creatin, the conversion of which into urea takes place in the liver and possibly some other glands. After removal of the kidneys, urea accumulates in the blood and gives rise to uremic poisoning. The inorganic salts are derived from the food.

The horse excretes nine to twelve pints of urine daily, and less at work than at rest. In herbivora, 30 per cent of the water escapes through the kidneys and 70 per cent through the lungs and skin; in carnivora, 60 per cent escapes through the kidneys, showing that there is relatively more urine in the latter. The ox secretes ten to forty pints daily. The urine of the pig resembles that of the dog.

The urine passes, drop by drop, from the kidney through a tube called the ureter into the bladder. The relaxation of the neck of the bladder and the contraction of its wall during urination are controlled by a spinal center in the loins. Disease of the spinal cord may cause paralysis of the bladder with incontinence of urine. In short, the kidneys, together with the lungs and skin, save the organism from rapid auto-intoxication by removing waste materials from the blood. The kidneys of the domestic animals are much less susceptible to disease than in man because animals work more constantly and the dietetic violations are not so flagrant; the organs are not so overtaxed by excreting surplus food. The layman's conception

of "trouble with the kidneys" or with the "water" when the horse shows colicky pain from indigestion, is purely traditional and mythical.

The skin.

The skin or external integument of the body has several functions : (1) It acts as an organ of touch. The long hair (tentacles) on the lips and nostrils have a special tactile function. (2) It is a protection to the body. With its hairy covering on top and a layer of fat underneath it retains the animal heat. The horn of the hoof, especially, is a poor conductor of heat. The length of the coat depends on the surrounding temperature. It changes twice a year in fall and spring. Work horses with a long winter coat sweat freely and are predisposed to "cold" and diseases of the lungs. This can be remedied by clipping if they are properly cared for. In the dog and cat, under excitement, and in the horse exposed to cold or to the direct rays of the sun after coming out of the stable, the hair becomes erect. This is caused by the contraction of the muscle fibers in the skin attached to the base of the hair. Blisters and other injuries to the skin may cause white hair to grow, which may be evidence of a previous disease of the parts. White horses can not stand heat so well as those of dark colors. The coat of the young animal often changes before it is adult. The black horse is a mouse-colored foal; brindle is yellow or lemon-colored in the puppy; the coach-dog puppy is entirely white.

(3) The skin has numerous glands secreting sweat or perspiration. Solipeds are the only domestic animals perspiring over the entire body. The glands in these species are most abundant. Perspiration is seen first at the base of the ear, then at the side of the neck and shoulders, and lastly over the hind-quarters. The ass and mule sweat less profusely than the horse. The quantity of perspiration in the horse in 24 hours varies with the temperature and humidity of the atmosphere ; at rest, about 6.4 pounds are given off ; working on a trot, 14 pounds, and 7 pounds emitted by the lungs.

Perspiration and radiation regulate animal heat. Perspiration lowers the body temperature ; a horse that does not sweat on a hot day is liable to suffer from "heat stroke." Some animals, as the frog, breathe through the skin, and it is asserted that in the horse oxygen and carbon dioxid interchange in minute quantities. The sweat glands also abstract from the blood waste products, such as urea, in inverse ratio to the kidneys. This is witnessed in eczema and other inflammatory eruptions.

Sweat contains serum-albumen and is rich in soda and potash. The loss of serum makes excessive sweating weakening and can be remedied by clipping. The serum mats the hair together and the salts form a fine sand-like coating.

The ox sweats on the muzzle and but rarely over the body ; the dog and cat sweat on the nose and foot-pads and the pig on the snout only. The dog really "perspires" through the lungs.

(4) Numerous sebaceous glands in the skin secrete a fatty substance, called sebum, which impregnates the skin and hair, keeps the skin pliable and the coat glossy. It lessens heat radiation and drains off the water. Horses living in the open need it for protection from rain and cold and should not be groomed too much. The sebum contains lanolin. The fleece of sheep contains large quantities of sebum which is used as a base for ointments. It is also found in the hoof and feathers. In cows the abundance of these glands gives to the ear, thigh and other parts the yellow color indicating butter qualities. Morphologically, the mammary glands are similar to the sebaceous glands.

Dandruff consists of dried epithelial scales, fat, silica, dirt and chlorophyl (the coloring matter of plants). Good grooming removes the dandruff, opens the orifices or pores of the gland ducts, stimulates the circulation and activates the sweat and sebaceous secretion.

The skin is also an absorbing surface for drugs. Extensive Spanish-fly blisters may cause suppression of the urine and even inflammation of the kidneys. In cattle, mercurial poisoning may be produced by mercuric blisters. The skin of bovines is very dense ; blisters are therefore not very effective and are little used.

Reproductive functions.

The organs of sex are most remarkably constructed in order not to fail of procreation and the perpetuation of the species. The practical breeder should have some knowlege of their function. The reproductive functions and processes are discussed at length in Mumford's article on *Some of the Principles of Animal-Breeding*, in Chapter III. A few additional notes are in place here.

The essential facts in the fecundation of the female egg by the spermatozoön of the male are the same in all species. The sexual act is con-

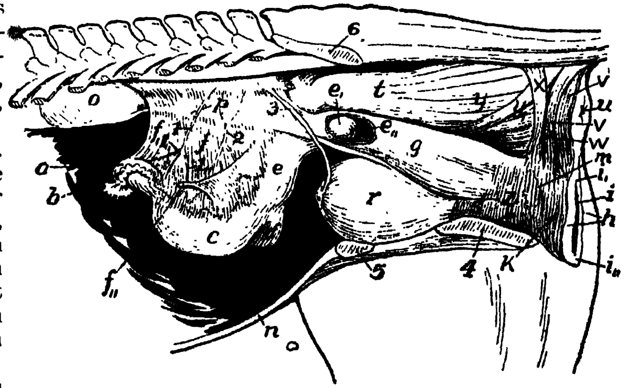


Fig. 26. Generative organs of mare. *a*, Right ovary; *b*, right oviduct; *c*, right uterine horn; *d*, left uterine horn; *e*, body of the uterus; e_1, vaginal part of uterus; e_2, mouth of uterus; *f*, broad ligament; f_1, suspensory ligament of the ovary; f_2, round ligament; *g*, vagina; *h*, vulva; *i*, vulvar cavity; i_1, posteri or commissure; i_2, anterior commissure; *k*, muscle constrictor cunni; *m*, corpus cavernosum vestibule; *n*, abdominal wall; *o*, left kidney; *p*, left ureter; *r*, bladder; *s*, urethra; *t*, rectum; *u*, anus; *v*, external sphincter muscle of anus; *w*, point where the levator ani muscle passes under the external sphincter; *x*, levator ani muscle; *y*, longitudinal fibers of the rectum; y_1, posterior band of fibers; *z*, muscle constrictor vestibule; 1, utero-ovarian artery; 1_1, branch to the ovary; 1_2, branch to the horn of the uterus; 2, external uterine artery; 3, umbilical artery; 4 and 5, sections through pelvic bone.

trolled by the nervous system. The penis, vagina and clitoris enjoy a special sensibility. The erection and rigidity of the penis are due to the engorgement of its blood-vessels and venus sinuses, which increases its size two or three times. The penis of the bull does not increase much in volume; it has a double curve like a flattened S and the unfolding of this curve gives to the organ its length. The penis of the ram has a pointed vermiform extremity that seems to be necessary for successful impregnation; after its removal the ram is sterile. The penis of the dog contains a bone and two ovoid enlargements at its posterior part. The sphincter muscles of the vulva grasp the penis behind these enlargements during copulation and "fasten" the male and female until complete relaxation occurs. Except in the dog and pig coition is of short duration. In the ram and bull it is almost instantaneous. In the horse it lasts ten to twelve seconds.

Ejaculation is due principally to a spasmodic contraction of the seminal vesicles and urethra canal. In the bull and ram, because of the pointed penis, a part of the seminal fluid may be ejected into the womb directly. In other animals it is deposited in the vagina. To insure the entrance of the semen into the uterine cavity, the uterus may be "opened." The os may be closed by a spasmodic contraction of its muscular wall or plugged up by thick mucus. To overcome this, first one and then two and even three fingers are slowly forced into the orifice. The semen may be injected into the uterus artificially. A sterile, long-muzzled, metallic syringe filled with the semen deposited in the vagina is passed through the os and emptied into the womb. The writer has seen mares which remained sterile before, become pregnant after this treatment. In the stallion ejaculation is accompanied by rhythmical movements of the tail, indicating the completion of the act.

The vitality of the sperm cells is destroyed by excessive acidity of the vaginal secretion from altered secretory functions or bacterial fermentation. This is overcome by flushing out the vagina with a solution of baking-soda. Washing out the vagina with a solution of yeast several hours before stinting has led to successful impregnation in mares heretofore barren. Loading the back and moving briskly are practiced to prevent straining after service.

The mucus from the prostate and Cowper's glands dilutes the semen; after too many services in one day it constitutes the principal part of the ejaculatory discharge and impregnation fails. The uterus, during the orgasm, expels a small quantity of mucus into the vagina.

In woman, who represents the most highly domesticated female, there is a period in life between forty and fifty years, called the menapause, when menstruation and fecundity cease. This phenomenon does not exist in females of domestic animals. The reproductive faculty ceases gradually with progressive senility. There are some remarkable instances of prolificness in the mare. A mare gave birth to twenty-nine foals in thirty-eight years (Degive). Some stallions are prolific until very old age.

At the period of puberty certain changes take place in conformation and temperament, more particularly in horses. The body becomes more filled out and better consolidated; the colt becomes less awkward, the head and neck more developed, the voice deeper, the temperament irritable and sometimes vicious; there is more life and vigor. The physical and mental characteristics peculiar to the sex become more accentuated.

Hybrids, which are the progeny of two different species, are, with few exceptions, sterile. The best known hybrids are the mule from the ass and mare and the hinny from the stallion and the jennet; also those from the sheep and the goat, the dog and the wolf, the dog and the fox. Hybrids possess sexual organs but spermatogenesis and ovulation are abortive. In bovines, the female of twins, the other being a male, is usually barren. It is called a "free-martin." Chauveau states, on what authority the writer does not know, that a mare stinted at short intervals to a stallion and an ass, gave birth successively to a horse foal and a mule foal.

Hermaphrodites, or "morphodites," as called by the laity, possess the genital organs of both sexes. They exist only among low animal life. In the fœtus of higher animals the primordial genital organs of both sexes are present and at a given time in its development the sex of the future adult can not be prognosticated. In the female, some of the male fœtal organs are preserved in a very rudimentary state, and vice versa with the male. In the so-called hermaphrodites, one or more of the organs are abnormally developed but never sexually perfect. We have seen the clitoris of the mare, which corresponds to the male penis, attain a length of several inches and protrude from the vulva like a penis. In the ox an incomplete uterus was found and the testicles occupied the position of the ovaries as in the fœtus. In the sow the ovaries have been found in the position of the testicles.

PHYSIOLOGY OF POULTRY

Digestion.—Fowls have no teeth. The jaws are encased by the horny beak. The mouth shows a large opening into the pharynx, the soft palate being absent; its roof has a cleft leading into the nasal cavities.

The esophagus is wide and at its lower part has a dilated pouch called the crop. In the pigeon the crop is double. In grain-eating birds the grain dilates the crop and becomes macerated by a watery secretion poured out by the glands of its mucous lining. During the latter part of hatching and the first week afterward the crop secretes a milky secretion which is regurgitated and fed to the young birds; it is abundant in pigeons, and is known as pigeon's milk.

The first stomach (ventriculus) is a sacular dilatation of the gullet continued by the gizzard. Its mucous membrane secretes an acid gastric juice, but no actual digestion takes place here because the cellulose covering of the grain particles is not crushed.

The gizzard or second stomach is the triturating apparatus. It is an ovoid organ with very thick muscular walls and contains small pebbles and sand necessary to crush the food. An acid secretion is also poured out here and proteid digestion begins. In flesh-eating birds the crop is absent and the gizzard thin-walled. The food of these fowls requires no trituration. The orifice between the gizzard and small intestine is small and large indigestible masses of food unable to pass through are vomited up. The solvent action of the gastric juice is strong.

In the intestine the food is acted on by the intestinal juice, the bile and the pancreatic secretion poured into the duodenum. Villi for absorption are numerous. Fowls have two club-shaped cæca six to eighteen inches long; they secrete a macerating fluid. The rectum terminates inside of the anal opening in a cavity called the cloaca, a dilated receptacle for the feces, the urine, the egg from the oviduct and the semen. The cloaca also lodges the penis.

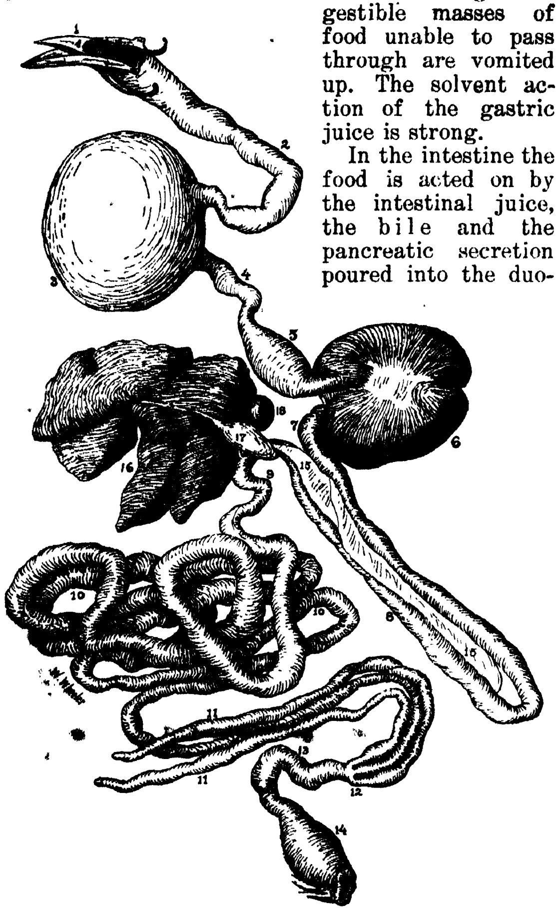


Fig. 27. The digestive apparatus of a common fowl. 1, tongue; 2, esophagus, first part; 3, crop; 4, esophagus, second part; 5, succentric ventricle; 6, gizzard; 7, origin of duodenum; 8, second branch of duodenal flexure; 9, origin of floating part of small intestine; 10, small intestine; 11, cæca; 12, insertion of cæca; 13, rectum; 14, cloaca; 15, pancreas; 16, liver; 17, gall-bladder; 18, spleen.

Circulation of the blood.

The circulation of the blood in fowls offers few practical differences when compared with other domestic species. The blood is characteristic in that the red blood cell is bi-convex, neucleated and oval instead of round. The temperature of the blood is much higher than in mammals, being 41° to 42° C., and even 44° C. in health. For this reason poultry are immune to certain diseases, as anthrax, whereas, when surrounded by a cold chamber or swimming in cold water so as to lower the temperature, such immunity ceases.

Respiration.

The disposition of the respiratory organs shows some marked peculiarities. The last ring of the windpipe is disposed to resemble a second larynx, which in song-birds is the source of vocal sounds. The lungs are small, fastened to each side of the backbone, and only partly fill the chest. A modified diaphragm is present.

Most remarkable is the air-reservoir or air-sac system in the avian species. The large air-sacs are situated between the backbone and the organs in the thorax and abdomen. They are connected with the lungs through the bronchial tubes. Peripherally they are continued by means of membranous tubes into a series of smaller sacs in the pelvis and between the muscles of the thigh, shoulder and arm. Here they enter small orifices in the bones and open into air-sacs in the marrow cavity. Bones so hollowed are the vertebræ of the backbone, breastbone, ribs, pelvis, thigh, shoulder-blade and arm bones. Contraction of the surrounding muscles compresses the air-sacs and expels the air through the lungs; when the compression ceases, the air is again sucked in and the sacs distended. Inspiration thus is passive and expiration active, and the air during both acts passes through the lungs. The interchange of oxygen and carbon dioxid is similar to that in the lungs. The air-sacs render the body lighter, promote equilibrium during flight and increase the range and power of the voice.

Reproductive functions.

The testicles, oval in form, are situated against the roof of the abdomen opposite to the last three ribs and in front of the kidneys. They lie close to a large vein, the vena cava, which can be readily torn in caponizing. There are no seminal vesicles. The semen passes through the spermatic ducts into the cloaca. In the crowing species the penis is only a small eminence at the cloacal margin, and is traversed by a furrow through which the semen flows. In ducks and geese it is of a corkscrew form. During copulation the anus of the male is placed against the cloaca of the female.

In the female there is one ovary, the left, the right being nearly always atrophied. The situation is the same as that

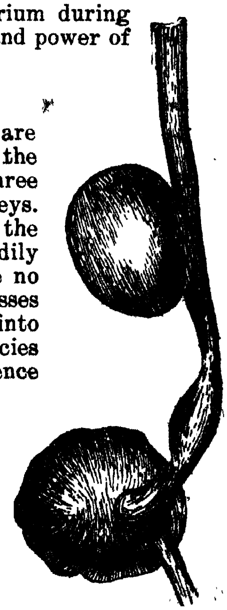


Fig. 28. Crop and gizzard of fowl.

of the testicle. In it can be seen the ripened eggs in the ovarian vesicles in various stages of development,—some young, small and white, others older, large and yellow.

The egg consists at first of the yolk or vitellus. In about six hours it reaches the lower third of the oviduct, surrounded by the albumen or "white of the egg," enveloped by a thin membrane in which calcareous matter is deposited to form the egg-shell. In about twenty-four hours it passes into the cloaca and thence to the exterior. During incubation life is maintained by the white of the egg, and respiration takes place through the pores of the shell. The male is not necessary for egg-laying, but the non-fecundated egg will not hatch. Nor is a separate copulation required for every fertile egg laid. In some species of poultry cohabitation with the male for a limited time suffices for the remainder of the laying season.

The urine.

The urinary apparatus in fowls is simple. The kidneys are oval in form. The urine passes into the cloaca, and is discharged mixed with the feces. In all species except the ostrich, the cloaca replaces the bladder.

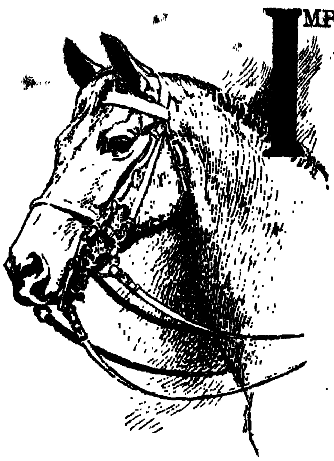
Literature.

Much valuable literature has been prepared on this subject. It is impossible here more than to suggest a few references. Robt. M. Smith, Physiology of the Domestic Animals; F. Smith, A Manual of Veterinary Physiology; Chauveau, A Comparative Anatomy of the Domesticated Animals; C. Cornevin, Traité de Zoötechnie, Rev. Générale de Médecine Vétérinaire; Mills, Animal Physiology; Prof. Dr. W. Ellenberger, Leisering's Atlas der Anatomie des Pferdes und der Übrigen Haustiere [Figs. 18–20, 22, 24–26, adapted from Ellenberger's Atlas].

CHAPTER III

THE BREEDING OF ANIMALS

By EUGENE DAVENPORT



IMPROVEMENT OF DOMESTICATED ANIMALS means their increased capacity for service to man. This great fact of service gives the keynote to all breeding operations and affords the only basis for rational procedure.

In this sense animal-breeding is to be distinguished from mere multiplication of numbers; it is distinctly qualitative, and the need for it lies in the fact that we are engaged in the attempt to adapt what were once wild animals to civilized conditions, and to readapt qualities useful to the themselves in a state of nature until they shall serve to the highest the needs and purposes of man.

Viewed from this standpoint, fads and fancies must be disregarded so far as business considerations permit, and everything not useful to man must be eliminated from consideration save only those qualities that have to do with the health and vigor of the animal, and hence with the perpetuation of his species. We have proceeded about as far along certain lines as we are likely to go until this principle is more fully recognized; until, for example, a combination of blood lines that ought to be made can be accomplished without destroying the commercial value of the animal because his pedigree is thereby unfashionable.

In most directions, function rather than form is the chief consideration. What can the animal do, rather than what is his form or color, is the question always to be in the mind of him who expects really to improve our animal servants. Form is striking because it appeals directly to the eye, but it has been greatly over-emphasized, not only as the direct object of breeding but also as an index of quality, for all studies yet made indicate that the correlation between form and function is in most cases far less than has been hitherto supposed.

The individual as a whole has occupied too much attention in the mind of the breeder. The single character is the real object of thought and selection in all successful breeding operations; it is the real unit of study in all problems of heredity, and the actual basis of operations in all cases of variability. The individual is but a single instance of the many patterns that may be cast out of the various characters that belong to the race, and he is not to be taken too seriously. The dominant

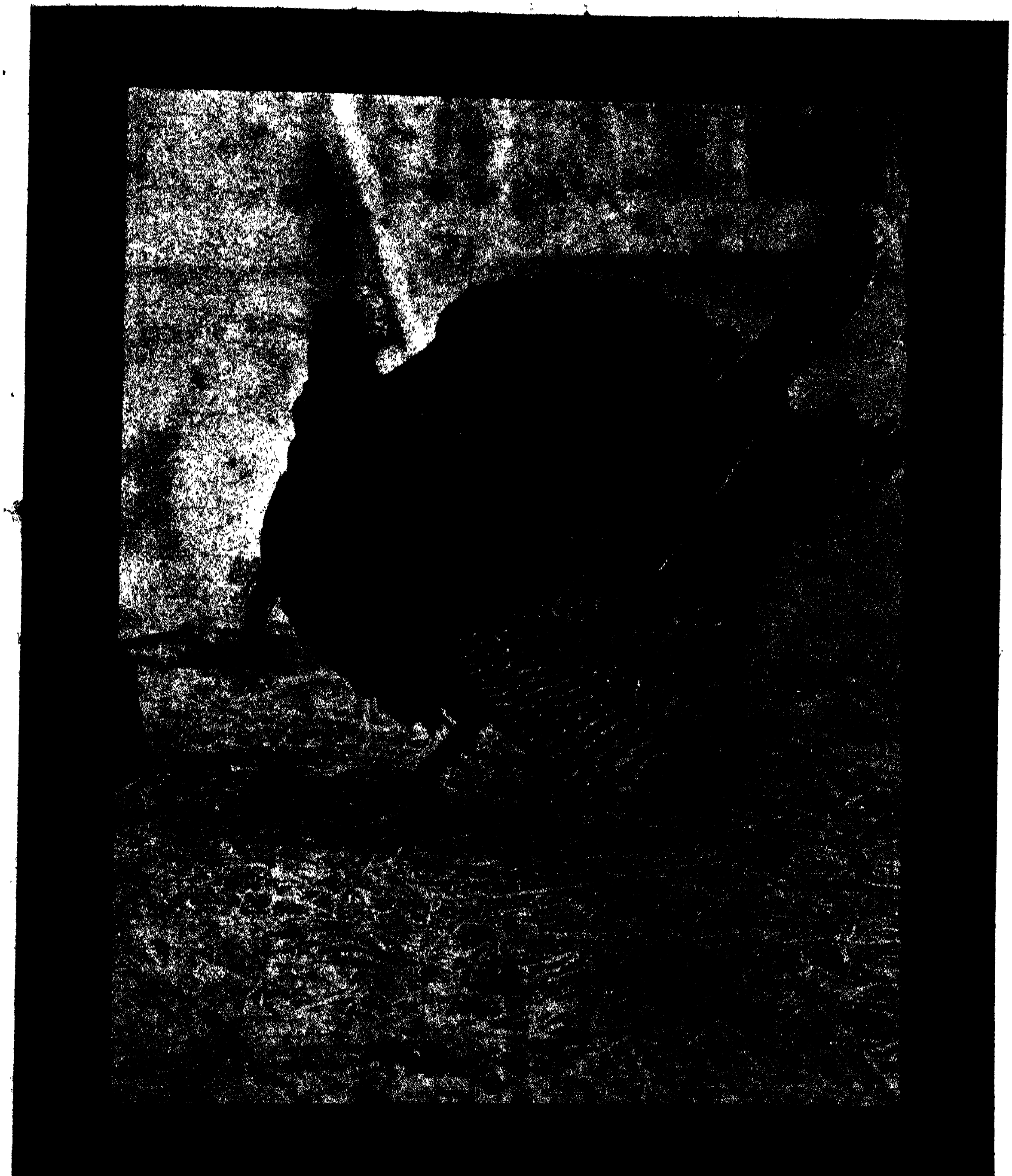


Plate II. Turkey gobbler, developed from the native stock, and the only species of North American bird that has contributed to agricultural live-stock. (See page 586.)

characters of the race, and their correlations—this is the great question in all the problems of the breeder and in all efforts at further improvement.

Breeding operations have been surrounded by too much of mystery and by far too much of that traditional knowledge accepted as truth only by reason of its frequent repetition. Breeding is by nature an exact science, but it will never come into its own until it is freed from the dense mass of superstition that has come to us largely through the "back alleys," handed down in whispers from mouth to mouth, clouded with inexact observation, faulty memory, and hastily drawn conclusions.

Present-day biological knowledge teaches us that under the law of chance all conceivable combinations of racial characters may arise, limited only by what is physiologically impossible. With this view of the case mere freaks are worse than valueless. When, however, the new thing represents a really new and fortunate combination of valuable characters, it is not a freak but a real contribution to the race. In no other business is there greater need of settling down to systematic operations based on definite conceptions of what is desired and accurate knowledge of the materials with which we have to work.

One broad distinction should always rest clearly in the mind of the individual breeder: Is he trying really to improve the breed beyond anything attained before, or is he endeavoring only to possess himself of as much as possible of what has been accomplished by others? If only the latter, his problem is comparatively simple. He can easily multiply individuals of known breeding, or, which is cheaper, resort to grading, and in four to six generations by the use of sires alone he can possess himself of practically all that has been accomplished by others.

If, on the other hand, he aspires to produce something distinctly in advance of what others have produced, really to create animal excellence, then he has a more difficult problem, for he is aspiring to the very acme of undertaking in this field. Much confusion arises in the public mind and in that of the individual by reason of insufficient clearness at this point.

Breeders' associations have much to do in the matter of advancing and upholding rational ideals of breeding. It is for them to distinguish sharply between that which is legitimate breeding and that which is mere multiplication of numbers. They have a work to do in increasing the practice of grading, both for the general good and for their own benefit; for the real business of all pure-bred flocks and herds is the production of sires to go on the common stock of the country and improve it. The over-enthusiasm of many breeders exerted to induce everybody, or, as many as possible, to breed pedigreed stock,—this mistake alone is responsible for many failures in the breeding business and for an insufficient market for sires.

In the matter of applying scientific principles to the business of practical breeding, one economic fact must be reckoned with,—stock must be bred that will sell, and if that is done then the breeders must produce what the people want. The desires of the buyer may be all wrong, and if so he should be educated to sane standards with as little delay as possible; but, until he is corrected, he must be dealt with on his own terms, for no man's pocketbook is deep enough to enable him to continue the breeding business much beyond what the buying public will support. The breeder must correct his own fads, whatever they may be, and associations cannot too rapidly free the business from the last traces of arbitrary standards. At both of these points the practical breeder can take aggressive ground, but beyond that he must be more careful, for he dare not break with the buyer. This is not saying that the buyer is to be encouraged in his notions, but it is saying that he must be patiently considered. And when the breeder warps his practice against his better judgment in order to continue in the business, he will not, if he is wise, submit to non-conditional surrender. He will stay as near to safe practice as circumstances will permit and will recover and possess himself of lost ground at the very first opportunity.

Students and breeders, alike, overlook the importance of grading as a necessary adjunct to successful breeding. Because it is not in itself a highly developed phase of the breeder's art, it is commonly left out of consideration in the discussion of breeding operations. The importance of an economic outlet has been alluded to and cannot be overestimated. The chief drawback to the business of further improving our domestic animals is the absence of an adequate market for surplus stock. Breeders are selling back and forth among themselves at large prices, but the market for sires, for grading purposes, is largely undeveloped, and, strangely enough, it seems not to be much noted by the breeders themselves, who are inclined to treat it as a problem impossible of solution. The fact is that the common stock of the country needs the improvement that can come only with a better grade of sires, and, at the same time, it is also true that the breeders are suffering from an insufficient market for the produce of their

flocks and herds. The business of every breeding herd is the production of good sires, most of which should go for grading purposes; and one of the largest and most urgent phases of the breeding business is to take hold of this situation boldly and to develop, among common farmers everywhere, an adequate market for sires.

From all considerations of business foresight, the breeder cannot afford to be ignorant of the principles that underlie the business he undertakes and with which he must reckon at every step. These principles are complex, not simple; many, not few; and their combinations are so varied and the results so diverse as to lead to the frequent assumption that breeding is a "jumble." Nothing is further from the truth. The laws and principles that underlie the breeding business are always present and always operative; they are well defined if not well understood, and if the same conditions are not apparently followed by the same results it is only because of our inability fully to recognize all the facts and all the principles in any particular instance. Much progress has been made in recent years toward securing accurate knowledge of these principles, and much yet remains to be learned. Important investigations are under way in many places from which new knowledge should come, and enough is already known to point fairly well to the direction from which further light may be expected.

SOME OF THE PRINCIPLES OF ANIMAL-BREEDING

By *Frederick B. Mumford*

The real object sought in breeding animals is the development of those characters which have a peculiar value to man. Breeding is an art, and the breeder's work consists in the development and improvement of those domestic animals which furnish such valuable products as labor, meat, milk, butter, cheese, wool, hair and leather. Breeding is also a science in that it deals with the principles of biology, and particularly with that branch of biology which we call evolution.

The successful breeder requires a knowledge of the reproductive functions and the laws of heredity, variation and selection, which together comprise the great problem of evolution in all its varied relations and manifestations.

I. Reproductive Functions and Processes

The unit of organic life is the cell, and the recent investigations have demonstrated that many of the unsolved problems of progressive development will ultimately find their solution in cell study. It is desirable therefore that the essential characters and functions of the cell unit be first described.

The cell.

The essential constituents of the cell consist of a mass of protoplasm in which floats a specially formed part called the nucleus. The cell wall is usually present and was earlier thought to be essential, but it is now known that cells may be functionally perfect when the cell wall is totally absent. In the substance of the cell occur all those processes of assimilation, absorption and formation which together determine the existence and duration of life in the animal body. The cell is therefore the seat of those highly important processes which are responsible for the hereditary transmission of characters. The fundamental causes of variation are to be found in the protoplasm of the cell. Unfortunately, our methods of investigation are not yet sufficiently accurate to discover the cell processes that determine when and how animal characters are transmitted. In the higher forms of life, groups of cells become more or less segregated, and while to a certain extent interdependent, they may carry forward an existence separate and apart from the organism as a whole. For example, the female reproductive cell, the egg or ovum, may be fertilized, developed and finally expelled from the uterus without fixing any of its peculiar characters on the mother organization.

The most important vital property of the cell is its ability to divide and subdivide, thus producing new individuals and new tissues in the same individual. This process of division brings about growth and consequent increase in size. The life of the cell, and its highly important content, protoplasm, reaches after a time a point when it has no longer the ability to accomplish its functional activities and death ensues. To provide for a continuation of the species, nature has endowed all organic beings with the ability to reproduce. The essential steps in the process of reproduction are first, the formation of an egg by the female and, second, the fertilization of this egg by the male fecundating fluid.

Essential organs of reproduction. (Figs. 26, 29-31.)

Ovaries.--The growth and development of the female egg-cell takes place in the ovaries. In the domestic animals these are two in number, generally bean-shaped and in more or less close proximity to the uterus and united with it by means of the egg-canals, the Fallopian tubes. The ovary consists of a mass of connective tissue permeated with blood vessels, nerves and lymphatics. A cross-section of the ovary shows the whole structure to be filled with closed sacs of various sizes, containing a fluid substance in which floats one, or at most, two cells with well-developed nuclei. These are the Graffian follicles producing later the ova or eggs that are destined to become the embryos of new individuals. At certain periods, recurring with considerable regularity, the female is said to be in heat and will then accept the attentions of the male. At this time, if the ovary be carefully examined, it will be seen that one or more of the

Graffian follicles has become considerably enlarged and has arranged itself close under the covering of the ovary. During the period of heat this follicle bursts through the covering of the ovary and is either lost in the abdominal cavity or, which is normally the case, passes into the Fallopian tube and finally reaches the uterus. It is not known at just what time during the period of heat the egg passes downward and finally reaches the uterus.

Fallopian tube.—The canal through which the ripened ovum reaches the uterus is not in close union at the upper end with the ovaries, but, on the contrary, empties directly into the abdominal cavity. This extremity of the Fallopian tube forms a trumpet-shaped enlargement possessing numerous finger-like projections. At the time the egg is thoroughly mature, this trumpet-shaped end closely encircles and imprisons that part of the ovary from which the matured egg is expelled. Under normal conditions the egg passes downward and finally reaches the uterus. It is not known how long the egg remains in the Fallopian tube, but in the mare it may be eight or ten days, and in the cow twenty-four hours (Verebungslehre, Keller). It may sometimes happen that the egg is thrown out into the abdominal cavity instead of passing into the Fallopian tube. In very rare cases such an egg may become fertilized and abdominal pregnancy result.

The uterus.—This organ is a large muscular sac in which the embryo is nourished until sufficiently developed to lead an independent existence. The walls are fortified with powerful muscles which play an exceedingly important part in bringing about the final expulsion of the fœtus at the time of birth. The inside lining of the uterus of the cow is thickly studded with wart-like projections, the so-called cotyledons which, connected as they are with the nutritive membrane (decidua) surrounding the fœtus, are closely associated with the nutrition of the embryo. The uterus is joined as above described with the Fallopian tubes, and on its lower and posterior part it becomes constricted and forms the neck or cervix which marks the end of the uterus and the beginning of the vagina. Failure to breed on the part of many females is often due to a severe contraction of the neck of the uterus, closing the entrance to the womb and thus preventing the male fecundating fluid reaching the female egg.

Egg-cell (ovum).—The egg-cell is the largest cell in the animal body. It is filled with dark-colored protoplasm and granular materials which have been stored during its development in the ovary. These materials form a reserve of nutritive substance for the rapid development of the embryo. The nucleus of the egg-cell is called the germinative vesicle, and this nucleus, after the fertilization of the egg, seems to acquire the power of slow movement. It moves to one surface of the egg and there undergoes changes preparing it for growth by division.

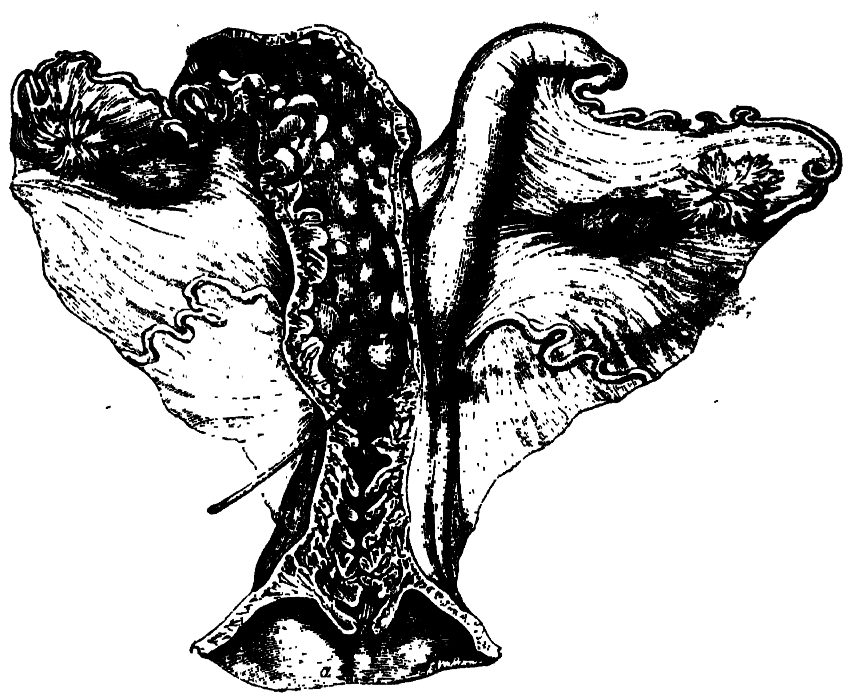


Fig. 29. Ovaria, oviducts and uterus of sheep (Owen).

The male cell. (spermatozoön.) — In all higher animals the male cell is composed of a nucleus and a vibratile cilium. The latter seems to exist for the purpose of propelling the male cell through a fluid medium. Thus, as a result of the activity of this organ the male cells may be and often are conveyed through the opening of the uterus through the uterine sack into the Fallopian tubes and finally to the ovary itself. This property of the spermatozoön renders the fertilization of the egg almost certain at some point of its descent from the ovary.

The male cells originate in the testicles of the male. The cells involved in the production of the spermatozoa are long tubules lined with epithelial cells with well-defined nuclei. This nucleus is the one part preserved throughout all the changes from the epithelial cell of the testicle to the finally perfect spermatozoön.

Fertilization of the ovum.

The spermatozoön pushes its way along until it meets the ovum through the tissues of which it

forces its way into the interior of the cell. The nucleus of the male cell passes through changes similar to those already described in the egg, and this changed nucleus unites with the nucleus of the ovum. Changes immediately occur which lead to the growth and development of the embryo. The new nucleus divides and subdivides, forming new cells and continually increasing in size and complexity, passes successively through those interesting stages of embryonic development, ending finally in a perfect individual with the characters of its parents more or less clearly indicated. It is thus that the process of fertilization results in a quantitative and qualitative distribution of the germ substance of both the male and female parents. The so-called daughter cell, which is formed by the fusion of the male and female cells, rapidly develops by the division of the nuclear substance. The significant result of this division is that every new cell is supplied with the germ elements of both parents and hence may exhibit the characteristics of both.

The mature breeding animal.

The reproductive functions in animals are not fully developed at birth, and after reaching their fullness, decline with age. As the animal approaches maturity, the sexual organs become fully developed and the sexual instincts are prominent. This stage in the animal's life is called the period of puberty.

Puberty.—In the female, puberty is coexistent with the ripening of the first egg, and indicates the time at which the young animal becomes capable of reproduction. The age at which puberty occurs, varies considerably with the breed of the animal and the methods of handling during the first months of the animal's life. Young animals generously fed on a nutritious diet, reach the period of puberty considerably earlier than those fed on a sparse diet. Cattle arrive at the period of puberty at four to eighteen months of age; horses at twelve to twenty-four months; sheep at six to ten

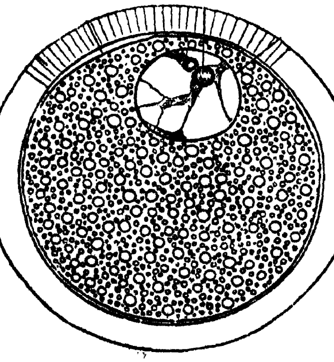


Fig. 30. Typical mammalian ovum (Schäfer)

months, and swine at three to seven months. The period of puberty does not represent the best time to breed. The artificial conditions which surround our domestic animals cause them to come in heat much younger than in a wild state. Great injury has been done by breeding females too young. The results of this practice have diminished the size and decreased the fecundity of many domestic animals, especially in the case of swine.

The best age to breed will vary somewhat with conditions. When the breeding animals are very valuable, it is important to give each individual an opportunity to develop perfectly. In commercial stock husbandry, it is sometimes more profitable to sacrifice somewhat of full development to early maturity and quick returns. The experience of breeders indicates that the following ages are the best for breeding: Horses, two to three years; beef cattle, twenty to twenty-seven months; dairy cattle, eighteen to twenty-four months; sheep, eighteen to twenty months; swine, eight to twelve months.

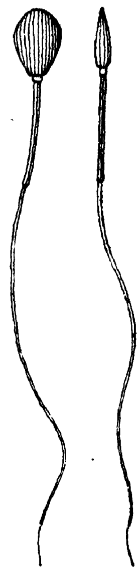


Fig. 31. Spermatozoön of *Bos taurus*, the ox.

The period of heat.—The beginning of puberty in the female is characterized by the ripening of a mature egg, and external symptoms which together are called the period of heat, or, in some wild animals, the rutting season. This period is accompanied by various manifestations. The external genitals become swollen and red, and this is accompanied by the discharge of a reddish mucous. There is frequent urination and sometimes a swelling of the mammary glands. The female is often restless and utters loud cries. The duration of heat varies, but normally continues in the mare two to three days, in the cow twelve to twenty-four hours, in the sow one to three days, and in the ewe two to three days. The frequency with which the heat recurs in different animals varies within rather narrow limits. The period of heat in the mare recurs rather irregularly, but most stallioners agree that the mare will come in heat nine days after delivery and each two or three weeks thereafter. The cow comes in heat forty to sixty days after delivery, if suckling the calf, and twenty to thirty days if the calf is taken away at birth. After the first appearance of heat in the cow, the period recurs with considerable regularity each three weeks thereafter. The sow invariably shows signs of heat three days after weaning the pigs, and recurs every nine to twelve days. The mare and ewe come in heat regularly during the spring and autumn months. At other seasons, the period is irregular and often entirely absent.

If the animal is bred at the time of heat, conception in normal cases will result, and, after a period of development in the uterus of the mother, there will be expelled from the generative organs a perfect individual. This period of development is called the period of gestation.

The period of gestation.—The period of gestation is the time between the impregnation of the ovum and the birth of the young. In egg-laying animals it is the period of incubation. The length of this

period is subject to considerable variation, determined by various causes not well understood. In general its length is in relation to the size of the animal. The following is a list of a few animals and the period of gestation of each :

Elephant	20 to 30 months.
Giraffe	14 months.
Buffalo	10 to 12 months.
Ass	12 months.
Mare	11 to 12 months
Cow	9 to 9½ months (285 days).
Bear	6 months.
Sheep and goat	5 months (21 weeks).
Sow	4 months.
Beaver	4 months.
Lion	3½ months.
Dog, fox or wolf	2 months.
Cat	50 days.
Rabbit	30 days.
Squirrel and rat	28 days.

The period of incubation extends as follows for domestic fowls :

Turkey	26 to 30 days.
Guinea	25 to 26 days.
Peahen	28 to 30 days.
Ducks	25 to 32 days.
Geese	27 to 33 days.
Hens	19 to 24 days (average 21).
Pigeons	16 to 20 days.
Canary birds	13 to 14 days.

Small breeds hatch earlier. Hamburgs hatch at the end of the twentieth day; game bantams at the end of the nineteenth day. Duck eggs hatch earlier under hens than under ducks, probably because of the higher temperature of the hen's body.

Small breeds of animals require rather less time than larger breeds, although early maturity shortens the time. Cold weather retards the process of incubation, especially. According to Youatt, all animals vary greatly without any known cause. The period of gestation in a horse has been known to vary from ten to over twelve months. Tessier reports 582 cases among mares with a range of 287 to 419 days; 1131 cows ranged from 240 to 321 days. Earl of Spencer reported 764 cows with a range of 220 to 313 days. L. F. Allen reports results for one year among a herd of 50 Shorthorns, Herefords and Devons, as ranging from 268 to 294 days, or an average of 284 days. Tessier observed 912 ewes with a range of 146 to 161 days. Darwin found that Merinos run about 150 days, while Shropshires and Southdowns require only about 144 days. Swine vary from 109 to 123 days, but usually run 116 days.

In practice there are some causes which hasten birth. A sudden cold spell will hasten the birth of a litter of pigs. Nervous excitement will hasten birth, especially in cows. Parturition of a neighboring cow often hastens birth. It is a popular opinion that male offspring require a longer period of gestation. There is not sufficient evidence to warrant this, but in one case of observation on cattle, the average period for five years was males 288 days, females 283 days. Heredity may influence the period somewhat.

Superfœtation.— Normally, animals do not come in heat while pregnant, but cases are known in which heat recurred during pregnancy. When this occurs and the animal is bred, double pregnancy may result and the mother may, at the same time, carry embryos of different ages in the uterus. This condition is called superfœtation. Several cases of this kind have come under the writer's observation in the mule-breeding districts of the South. Mr. W. E. Carmichæl, of Shelbyville, Missouri, bred a mare to a stallion and thirty days later to a jack. At the end of the period of gestation the mare gave birth to twins, one a mule and the other a horse-colt. They were both dead at birth. A mare belonging to Charles Bailey, of Gault, Missouri, dropped twins, a mule and a horse-colt. Both lived but a short time.

Superfecundation.—A similar condition, known as superfecundation, occurs when a female is covered by two different males during the same period of heat, and conceives to each.

Pregnancy.— When, in the normal course of events, the female comes in heat and is bred to the male, pregnancy results. The more important indications of pregnancy are : (1) The cessation of the symptoms of heat which, normally, do not recur during pregnancy. However, this is not an infallible sign of pregnancy, as some mares will accept the services of the male when pregnant. (2) A sudden change of disposition, after service, from a more or less nervous, excitable and sometimes vicious mare to a condition of unusual gentleness is a good symptom of pregnancy. (3) Tendency to lay on fat and gain in weight. (4) Increased size of the abdomen and depression of the loins. (5) After the seventh month in the mare the foal may be felt by pressing the hand firmly against the abdomen, in front of the left stifle. The movements of the foal may also be felt, especially after the mare has taken a drink of ice-cold water.

The care of pregnant females of the domestic animals is of vital importance to the initial existence as well as future welfare of the unborn young. When possible, the pregnant animal should have the run of a good pasture at least a part of the day. Exercise is a prime essential in the care of breeding animals, and no other treatment can replace it. Especial care is needed to encourage exercise in those domestic animals that are closely housed in winter. Rations which furnish all the necessary nutrients in the right proportions must be fed to insure the normal development of the unborn young.

Parturition.—At the end of the period of gestation, certain important changes take place in the body of the mother which result finally in the expulsion of the young animal and the beginning of its existence as an independent being. This is called the period of parturition. As parturition approaches, certain external changes occur which warn the breeder to be prepared with such aid as occasion may demand. Parturition is heralded by a swelling of the udder and sometimes of the abdomen in front of the udder. Two to six days before the final expulsion of the fœtus, a wax-

like substance exudes from the teats. The vulva becomes slightly swollen and has an appearance of redness. Shortly before the labor pains actually begin, the belly droops, the flanks and rump fall in and the loins become depressed. The animal evinces great uneasiness, continually lying down and getting up, and in other ways exhibiting unusual anxiety. In normal cases violent muscular contractions, known as labor pains, finally result in the birth of the young animal.

Difficult parturition.—It may sometimes happen that the mother is unable to cause the expulsion of the fœtus. This failure may be due to a wrong presentation of the fœtus, to disease or weakness, fractured hips, or, in rare cases, to twins, which tend to come forth together. In such cases artificial aid is imperative. The normal presentation consists in extending first the fore-legs and head, and in this position the young animal may usually be born without outside assistance. It frequently happens that other parts of the body of the fœtus are first extended, in which case it becomes necessary to rearrange the young animal before attempting to withdraw it from the mother. If the hind-legs are first extended it is possible for the animal to be born in this position.

To determine the character of the presentation, it is necessary to make an examination. In making this examination, the most rigid cleanliness should be observed. The hands should be thoroughly washed with soap and hot water, and the hands and arm carefully greased with fresh lard or vaseline. Introduce the hand and arm into the vagina with great care and gentleness when the mother ceases to strain. Determine whether the fœtus is in proper form to be delivered, and, if so, let nature have ample time to expel the young animal in the regular way. If the mother is unable to accomplish this, then it becomes necessary to give some aid. At all stages extreme gentleness and patience should be exercised. The fewer helpers at such a time the better. After delivery, leave the animal alone for some time to rest. In very difficult cases it is always better to call in the services of a skilled veterinarian.

Abortion.—Abortion is defined to be the expulsion of the fœtus before it is viable. If the fœtus is expelled prematurely and lives it is more often spoken of as premature birth. There are two important kinds of abortion, contagious and non-contagious. Non-contagious abortion is usually accidental, and may be caused by an injury, by great nervous excitement or irritation, extreme and sudden fright, the sight or smell of fresh blood, the eating of ergot, emaciation and disease, confinement in dark, damp, and unhealthy stables, and severe cases of indigestion. In practice, abortion may occur as the result of a blow inflicted by a vicious caretaker, by hurrying pregnant animals through a narrow doorway, by giving a heated animal a drink of ice-cold water, and in other ways suggested by the causes recounted above. The treatment of non-contagious abortion is very simple and consists in removing the causes.

Contagious abortion.—Contagious abortion is a germ-disease caused by the germs entering the generative system. These may be carried from one female to another by the male. This is one of the most serious diseases with which the breeder has to contend, and often baffles the most careful and skillful stockman. The symptoms of this condition are similar to those of parturition, except that the symptoms occur long before the period of gestation has run its normal course.

Fig. 32. Normal presentations of foal. *a*, Lumbo-sacral: *b*, vertebro-sacral

The treatment for this condition is exacting and often unsatisfactory. When an animal has aborted, the undeveloped fœtus and afterbirth, together with the stall litter, should be carefully collected and burned. The stall should be sterilized by the application of lime and other antiseptics. The aborting animal should be quarantined, and her generative organs washed out with an antiseptic solution composed of chlorid of zinc in the proportion of 1 to 1000.

When contagious abortion is known to be present in the herd, medical treatment is demanded. This treatment had best be given under the direction of a veterinarian. If the breeding herd is a valuable one and the condition persists, it sometimes becomes necessary to separate the young female breeding-animals from the contaminated herd and breed them to a healthy young bull known to be free from the germs of contagious abortion. [This subject is further discussed on page 143.]

Fecundity.—Fecundity is the quality in animals of producing young in abundance. It is synonymous with fruitfulness, prolificacy and fertility. This quality is greatly influenced by various natural conditions, but especially by the more or less artificial conditions resulting from domestication. The

fruitfulness of animals is influenced by climate, confinement, kind of food, age, size, degree of fatness, crossing, inbreeding, disease, season, changed conditions and heredity.

In general, a cold climate is unfavorable to fecundity, while a warm or temperate climate is favorable. Confinement and lack of exercise are frequent causes of unfruitfulness. Wild animals in confinement do not breed readily. Flying squirrels produce not more than two young at a litter in captivity, while in a wild state they produce six. Ostriches in captivity lay twelve or fifteen eggs annually, and in their native haunts thirty. Darwin describes an experiment with domestic fowls in which the eggs of those closely confined were only 40 per cent fertile, of those in partial confinement 60 per cent, and of those given full freedom 80 per cent strongly fertile.

The kind of food seems to have in some cases a profound influence on the generative functions. Entomologists have found that the queen bee, a perfect female, owes her sexuality to the royal food which she receives while in the larval state. The common worker grub may be exalted to royalty by supplying it with the queen bee food. Sugar fed in quantity to the domestic animal is known to affect unfavorably the fecundity of the animal. An exclusive ration of corn supplies too large a proportion of fat-forming foods and may injure directly the breeding powers of animals.

Animals excessively fat often fail to breed at all ; or, if they do breed, they produce a small number of young. On the other hand, partial starvation is equally harmful to the procreative powers. A generous supply of nutritious food, regularly given, is at all times the most favorable condition for the highest fertility. Pasture grass seems to be of all foods the most satisfactory from the standpoint of the breeder. It is asserted by some horsemen that it is difficult to get mares in foal while running on clover pasture.

The fertility of animals is greatest at full maturity. Young animals are less fecund. It is thought that the practice of breeding sows, ewes, cows or mares at too young an age, if persisted in, will eventually diminish materially their fecundity. Small animals are usually more fecund than larger ones. The ewe, sow, dog, cat and rabbit are much more fruitful than the cow or horse.

Crossing in both plants and animals results in greater fecundity. On the other hand, continued inbreeding undoubtedly tends to diminish fecundity, and probably in the end to destroy fertility itself. Some seasons seem to furnish conditions which are peculiarly favorable to greater fecundity. Changed conditions frequently interfere temporarily with the fecundity of the domestic animals. This is most often observed in the case of imported animals. A stallion recently imported may, for a few months after landing in this country, fail to get any mares in foal. The stallion "Brennus," a Percheron, was used at the Missouri Agricultural College soon after his importation. He failed to get a single mare in foal. Afterward he became a very successful breeder.

Heredity is, perhaps, of all factors the most potent in determining the inherent ability of animals to produce young in abundance. It is possible, by selecting the females from large litters, to increase the fecundity of our animals. Twin-born females from species normally producing one young at a birth will tend to reproduce this quality in their offspring. An exception to this is to be noted in the case of twins born to a cow in which one is a bull and the other a heifer. In such cases the heifer is usually sterile and is called a "free martin." [See page 24.] It not infrequently happens that some particular female fails to become pregnant to a certain male, but will readily conceive to another male. This is called incompatibility.

There are numerous remarkable cases of fecundity on record which tend to show the possibilities of increase in our domestic animals. A Clydesdale mare belonging to G. W. Henry, of Iowa, gave birth to 19 foals. "The Rural New-Yorker" pictures a cow 22 years old that has had 20 calves and was again pregnant. "The Country Gentleman" describes a Leicester ewe as giving birth to 6 lambs. The same paper describes a sow of ordinary breed that produced 23 pigs in 1 litter and 85 pigs in 5 litters.

Barrenness.— Barren animals are not uncommon, but this failure to breed may be due to a variety of causes. The non-development of the ova, tumors of the ovary, or fatty degeneration of the ovaries or Fal-

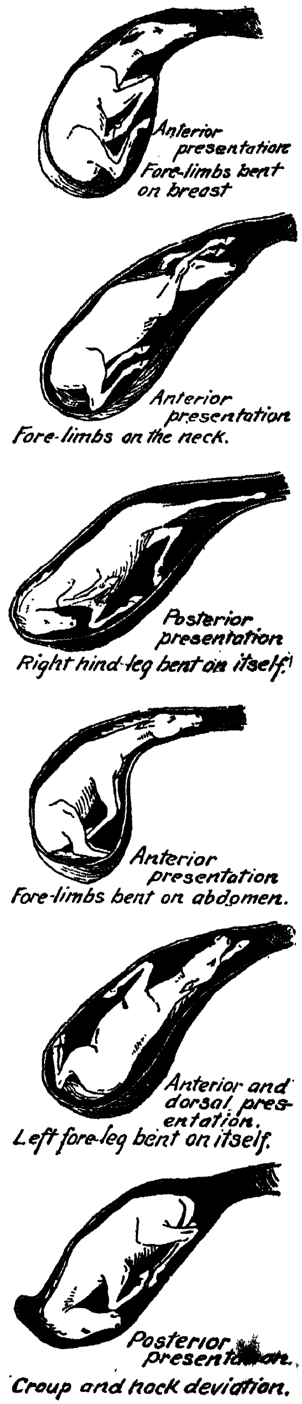


Fig. 33. Abnormal presentations of foal.

lopian tubes may result in permanent sterility. In such cases the female usually fails to come in heat.

Fig. 34. Abnormal presentations of foal. [Figs. 32–34 adapted from Special Rep., Bur. Animal Ind., 1890.]

When the animal comes regularly in heat, but does not become pregnant after repeated breeding, the causes of barrenness may be local and curable. When this condition exists, the failure to become pregnant may be due to a contraction of the muscles of the cervix or neck of the womb. This difficulty may be overcome by a treatment called opening. Acid discharges from the generative organs are also a frequent cause of barrenness. This condition has been treated very successfully by introducing ordinary yeast, after preparing as for bread-making, and then diluting with warm water and injecting into the uterus just before breeding. A common cause of partial sterility in all domestic animals is a failure to provide regular and sufficient exercise. No medical treatment can correct this deficiency.

[For additional notes on the reproductive functions and processes, see Harger's article on *Physiology of Domestic Animals* in Chapter II.]

II. Breeding.—Variation, Selection and Heredity, and their Applications

The improvement of the domestic animals has come about through the observance of natural laws which have acted and are still potent in determining the limits of possible improvement. Variation, which may be defined as the appearance of any characters not existing in the ancestors, has been a cornerstone in the development of the most valuable races and breeds of domestic animals. The next step has been the intelligent selection of those variations of peculiar value. Finally, heredity has been relied on to fix and perpetuate desirable variations which have been selected by man.

Variation.

The organization of all plants and animals is more or less elastic and permits of considerable variation from the established type; thus, all of our domestic animals are constantly tending to depart from the characters of their ancestors. This tendency to vary is retarded or accelerated by many causes. Among these we may mention changed conditions of life. Horses taken to the barren and cold islands of Shetland become gradually smaller and hardier, like ponies, and the hair becomes thicker and longer. Long continued exposure to such conditions ultimately results in the production of an animal like the Shetland pony, small in size, extremely hardy, able to withstand the most severe winter climate and to subsist on a minimum of food. Horses taken to the rich lowland pastures of middle Europe gradually become larger and more powerful, like the Percherons. Miles reports a case of an Englishman who introduced greyhounds on the high plateaus of Mexico for the purpose of hunting the swift hares. These greyhounds were unable, because of the rarefied air, to run down and capture the hares, but the offspring of these greyhounds could easily run down the hares without fatigue or exhaustion.

Heredity is also a cause of variation. The union of two animals with diverse qualities must necessarily result in offspring unlike either parent, hence the variation from the parent. The constant union of characters brought about by heredity must produce new combinations of characters and thus cause variation. Thus, in crossing the Shorthorn and the black Aberdeen-Angus or Galloway, there is usually produced an animal of blue-gray color, which so far as color is concerned is totally different from either parent. This variation is due to heredity and not to any changed conditions.

Variation may also result from habit or the use or disuse of parts. The constant use of any organ of the body tends to vary it in accordance with the work required. The milking habit in cows may be increased by judicious use, or destroyed by disuse. The practice of drying-up beef cows that are to be shown is almost certain to result in the gradual loss of the milking function. The American saddle horse has been selected and bred for many years because of the facility which he exhibits in performing certain gaits which are easy to the rider. These gaits have been so long required of this horse, that now the young colts a few days old frequently fall naturally into these more or less artificial gaits.

The principal causes of variation are unquestionably climate and food, and of these the greatest single cause is excessive food supply. But there

seems to be in most animals an inherent tendency to vary, which cannot be explained by relation to the influences of external causes. All the domestic animals, placed as they are, under more or less artificial and changed conditions, are much more variable than their wild prototypes.

The variations which occur in the domestic animals are some of them favorable and some unfavorable. Many of the variations are such as to make the animal distinctly less valuable than before, while others, although apparently small in amount, may give evidence of the highest value and usefulness to man. It is the highest achievement of the successful breeder to be able to detect those selected variations which give promise of great value to man. This is the art of selection.

Selection.

Selection is defined as the favoring and fixing of those characters in plants and animals which are to survive. It is a separation of desirable and useful variations from those that are undesirable. Scientists recognize two kinds of selection, natural and methodical.

Natural selection.—Natural selection is nature's method of preserving the species. In nature variations occur, some of which give to their possessors an advantage in the struggle for existence. These variations are preserved and strengthened. Other variations, in a measure, unfit the animal or plant for its environment, and, in the struggle for life, those individuals possessing such variations sooner or later succumb. Natural selection is the preference which nature shows to those individuals best adapted to their surroundings. Those organisms that possess the most favorable and the fewest unfavorable variations will be preserved. The less fortunate ones can survive and reproduce their kind only when food and room are abundant. As either food or room becomes scarce, the weaker will go down before their more fortunate neighbors. This is natural selection, or the survival of the fittest. Survival of the fittest does not necessarily mean the survival of the best, nor even of the highest type, but it does mean the survival of those possessing the greatest ability to live and get food under particular conditions.

There are many examples of the workings of natural selection. The domesticated duck, derived originally from the wild form, during its period of domestication has increased largely the size of the leg muscles, and has suffered a corresponding decrease in the size and strength of the wing bones and muscles. The wild duck has small and weak leg bones and muscles, but large and powerful wing bones and muscles. The case of the Shetland pony described under "variation" is an excellent example of the results of natural selection. Lamarck mentions the giraffe as an example of the development of certain parts as a result of continued and excessive use. The giraffe originally fed off the ground, but during some stage of its existence, herbage on the earth being scarce, he began to reach for the leaves on the trees. As it became necessary to reach higher the neck necessarily became longer and longer until we have the long-necked giraffe of the present time. The common garden mole, living exclusively under the ground, has no need for eyes. As a result of the disuse of these organs the mole now has almost entirely lost the organs of sight. Fish in caves are usually blind. The many examples of mimicry are also instances of natural selection. The whippoorwill looks so much like the limbs on which he alights that he can scarcely be distinguished from the knots on the trees. The tiger is striped, and, in the jungles which it inhabits, can with difficulty be distinguished from the grass at a few paces.

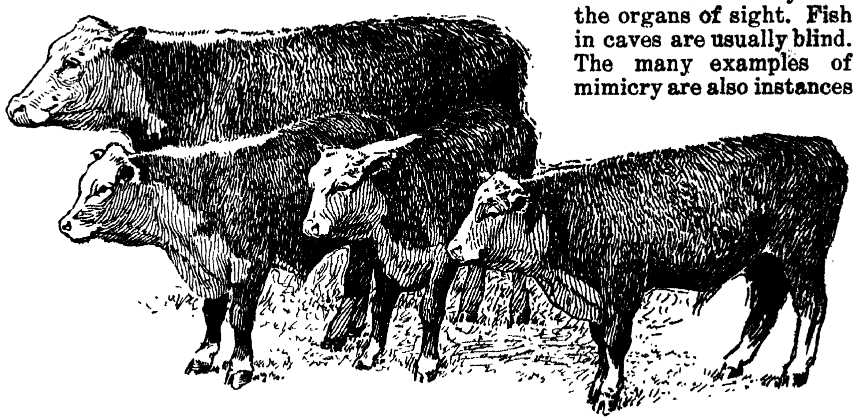


Fig. 35. A fecund Hereford cow with triplet calves. Note the close resemblance of characters.

Methodical selection.—Methodical selection is practiced by man and may be defined as a favoring and fixing of characters especially useful to mankind. It is a survival of the best. This does not necessarily mean the survival of the strongest nor of those best adapted to live and thrive in the state of nature. Methodical selection applies only to plants and animals under domestication. The first step and most important for the breeder of domestic animals is to fix in his mind an ideal type embodying all the desirable characters which it is wished to perpetuate. The breeder of beef cattle must understand thoroughly the "beef type," and in all of his selections must keep in mind the characteristics which are necessarily present in the meat animal. The breeder of dairy cattle must have in his mind a clear ideal of the "dairy type." This type we have learned by long experience is always found associated with those individuals which possess the ability to produce large amounts of milk and butter at the least expenditure of food and energy. There are all degrees of methodical selection, from that employing the

highest skill and intelligence down to a little more than natural selection. Many savages employ a low form of methodical selection. Some tribes kill the males and preserve the females. Others kill dangerous beasts of prey.

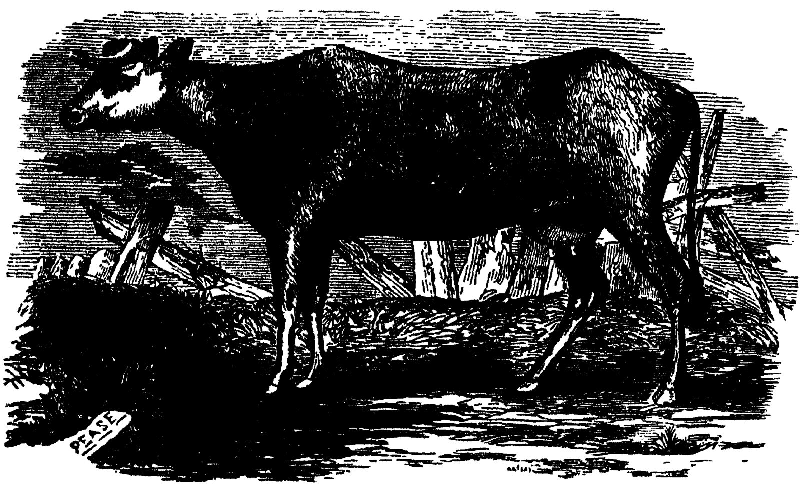


Fig. 36. The "Old Jersey Cow." An engraving supposed to be from a drawing made on the island of Jersey by order of the editor of "The Country Gentleman" (1853). (Compare Fig. 37.)

In practice no character is too trifling to consider. The Arabs will not own a horse with four white feet. Practical feeders think a wide muzzle is always associated with the best feeders. The successful breeder must possess skill to select and combine the faintest characters. He must be quick to detect the slightest variation away from his ideal type, and, above all, he must have the courage to kill and destroy those individuals which do not possess the desirable variations. In fixing valuable characteristics we often unconsciously fix others that are undesirable. Many families of highly developed beef animals have lost, to a certain extent, their fecundity. The same is true of some of the most highly bred types of domestic swine. In striving for fineness of bone, extreme quality and early maturity, the animals themselves have become too small, and, in the case of some swine, the bone has become too small to support the weight of the animal. The skillful breeder is he who is able to maintain an equilibrium of the best characters.

When the ideal animal has been secured through variation and selection, his good characters become perpetuated through heredity.

Heredity.

Heredity is defined as the influence exerted by parents on the offspring. It is tersely expressed in the aphorism "like produces like." It is the tendency of the offspring to be like the parent. Heredity is directly opposed to variation and represents stability of character in the organic world. So common is the fact of heredity that we have come to regard it as a universal law of nature. The influence of this phenomenon is not confined to any organ, or any particular part of the organism. It is universal in its application and determines the physiological, psychological and pathological conditions of all organic beings. It is a foundation principle of the greatest possible use to the breeder of domestic animals. It was known and recognized by the ancients. The Jews recognized its existence in their social organization of families of priests, kings and others.

Heredity of normal characters.—The commonest evidences of heredity are to be found in the external structures of animals. The offspring resemble the parents in stature, form and feature. The peculiar markings of different breeds of cattle are strongly transmitted. The Herefords invariably transmit a white face. The Aberdeen-Angus cattle inherit the coal-black color and polled heads. The Devons are of a deep dark red. The heavy draft horses inherit from their ancestors a powerful blocky and massive structure. The Thoroughbred and the trotting horse receive by inheritance the slender build and nervous temperament of these particular breeds. The tendency to lay on fat is observed in certain breeds and certain families within a breed. Some sheep in a large flock ever remain fat on the same food that others in the flock consume and yet remain in thin condition.

The quality of fecundity is greatly influenced by heredity. It is a well-known fact that the selection of ewe lambs from twins rather than single births will increase the average fecundity of the flock. Longevity is also transmitted. The inheritance of immunity from smallpox and other diseases is a known medical fact. It seems probable that breeds of swine could be established that would be perfectly immune from hog cholera.

The transmission of characters is not always

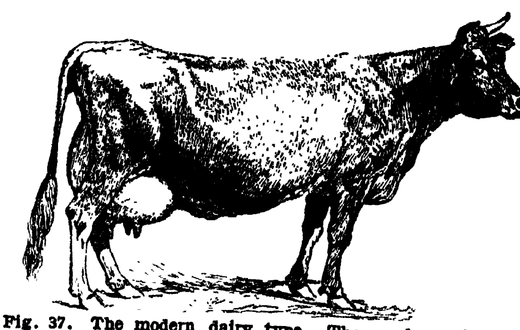


Fig. 37. The modern dairy type. The product of definite and careful breeding. Jersey cow. Figgis 76106. Hood Farm, Lowell, Mass. (Compare Fig. 36.)

exhibited directly from parent to offspring but may be observed in the grandchildren or even later generations. Ordinarily it would seem natural to suppose that the male persons would more often determine the dominant characters of the male offspring and the female parent the ruling qualities of the female offspring. It seems, however, that in an equal number or in a majority of cases, the male is most like the mother and the female most like the father. This is called cross-heredity. If this fact be true, it is of the utmost importance that in selecting a dairy bull more attention should be paid to the dam of the bull, and in selecting all males it is of the highest importance that sharp attention be given to the characters of the dam.

moral instincts are determined to a greater or less extent by hereditary influences.

Heredity of abnormal characters.—Not only are the normal or natural characters transmitted from parent to offspring, but the unnatural or abnormal developments seem likewise to be influenced by this phenomenon. We can perhaps understand how a constitutional disease may become hereditary, but when the loss of an organ or the non-development of the extremities of the body is transmitted, it is more difficult to understand. It is related, that, in 1828, David Ely imported into this country a short-eared Saxon ram. This animal had a peculiarly fine fleece of wool. In the locality where this animal was used for breeding, the farmers came to associ-

Fig. 38. Variation in type. Beginning at left two sisters. Cow on right is daughter of one in center. Note refinement and improved shape from left to right.

Not only the physiological characters are controlled by the dominating character of heredity, but the psychological characters as well. There is in fact no distinction to be made between physiological and psychological heredity, for, as Spencer said, "No thought, no feeling is ever manifested save as a result of physical force." If, therefore, we demonstrate the fact of physiological heredity, we are bound to accept the existence of psychological heredity. One of the most interesting cases of psychological inheritance is the transmission of instincts. Pigs invariably squat when frightened. This instinct was developed in nature as a means of protecting the animal from its enemies. Dogs turn round and round before lying down even on a perfectly smooth floor. This is the persistence or the instinct of habit possessed by wild dogs living where grass was abundant, where turning round was necessary to make a bed by tramping down the grass. The instinct to nurse is possessed by all young animals. The senses are strongly transmitted. The sense of touch of all extreme northern races is obtuse and imperfect. The sense of sight in all of its various modifications is most certainly transmissible. The Fuegians, says Darwin, can see distant objects more clearly than the English. Myopia is increasing rapidly among all nations engaged in intellectual pursuits. Dr. Colin of Breslau examined children in all grades and found that myopia occurred as follows: primary schools, 6.7 per cent; middle schools, 10.3 per cent; normal schools, 19.7 per cent: gymnasia and universities, 26.2 per cent. This acquired myopia is apparently transmitted. It seems equally certain that the

ate the short ears with excellent wool, and selected the short-eared animals for foundations for breeding flocks. The result was that in a few years they established a breed of almost earless sheep. Anderson states that a rabbit produced in a litter an animal with only one ear. From this one individual was established a breed of one-eared rabbits. The same authority also mentioned a female dog with one leg deficient that produced several puppies with the same deficiency. It is not so difficult to understand how a character or a set of characters developed as a direct result of a specific need on the part of the animal may be transmitted readily by heredity, especially if this character has appeared in the ancestors for many generations. On the other hand, it is much more difficult to conceive of the transmission of abnormalties or mutilations, yet such cases are not rare.

Under the term "prodactylism" is considered the occurrence of extra fingers and toes. Supernumerary digits may be attached to either the inner or the outer side of the hand, forming an extra thumb or little finger. Darwin remarks that "the presence of a greater number than five digits is a great anomaly, for this number is not normally exceeded by any existing bird, mammal or reptile. Nevertheless, supernumerary digits are strongly inherited." They have been transmitted through five generations. Struthers gives the following interesting instance: In the first generation an additional digit appeared on one hand, in the second on both hands, in the third, three brothers had both hands, and one of the brothers a foot affected, and in the fourth generation all four limbs were affected.

However, these supernumerary digits are not always transmitted.

The writer observed in a certain locality a trotting stallion affected with a condition known as parrot mouth. In this condition the upper jaw extends over the lower jaw, so that the ends of the teeth do not meet, thus preventing the ordinary wear and resulting in the gradual elongation of the upper teeth. Many of the colts from this stallion inherited this peculiar abnormality. The writer also observed at the Michigan Agricultural College a Shropshire ewe affected with an opposite condition, namely a bull-dog jaw. In this case the lower jaw projects beyond the upper jaw. Twin lambs from this ewe were each affected in the same way as the mother. The classic experiments of Brown-Sequard on guinea pigs, in which it was found that an incision of the spinal cord resulted in epilepsy, and that the offspring of these artificially imposed epileptic animals were likewise affected in the same way, are well known. The transmission of mutilations is exceedingly rare, and these experiments have perhaps not been repeated a sufficient number of times to make their universal acceptance justifiable.

Heredity of diseases.—It is an important fact that pathological conditions are subject to the same laws of heredity as normal and desirable characters, and these are often transmitted from parent to offspring. Some diseases are much more surely hereditary than others. When a disease manifests itself at birth it is called congenital. If a disease appears later in life the animal is said to have possessed a predisposition to the disease. This tendency of the diseases of parents to reappear in their offspring was recognized by the ancients. Early medical writings contain many references to this fact. Darwin notes that 50 per cent of the cases of gout recorded in hospital practice were hereditary. Insanity is known to run in families. A surgeon relates that his father, brother and four paternal uncles were all insane. The case of a Jew is on record whose father, mother, and six brothers were all mad. Diseases of the eye are frequently transmitted. A stallion in France became blind from the effects of disease and all of his progeny had the same disease before the age of three years. The famous Irish horse Cregan was the progenitor of a race of horses decidedly predisposed to malignant ophthalmia and this tendency was observed even to the fourth and fifth generations.

Bone diseases are likewise supposed to be readily transmitted. A mare affected with ring bone, being unfitted for farm work, was kept as a breeder. Her colts were well formed and at two or three years of age sold readily. No indications of the disease were noticed at that time, but at the age of five or six they were all affected with ring bone, some so seriously as to unfit them for work. A stallion became affected with thick leg and grease heel at the age of four years. His colts inherited this same disease. Dr. Miles states that scrofulous diseases are a common occurrence among horses, cattle, sheep and swine. Under this designation occur all of those diseases which tend to produce tubercles. All these diseases are either transmitted, or, which seems more probable, animals inherit the defective organization which predisposes the individual to this disease.

Many animals transmit indirectly to their offspring through a defective conformation or an unbalanced proportion of parts. Thus, a horse with a narrow hock, looked at from the side, is predisposed to spavin. A short os calcis and a straight hock predispose an animal to curb. Veterinarians are singularly unanimous in their decision that certain diseases are inherited. Among these are contracted feet, ring bone, spavin, splints, curb, laminitis or founder, roaring or broken wind, melanosis, specific ophthalmia and crib-biting. These diseases are transmitted either directly or as the result of a predisposition. The breeder should recognize the danger from using animals affected with any of the diseased conditions mentioned.

We are therefore compelled to believe that every organ or set of organs as well as the mental and even moral characters are subject to the universal law of heredity. Characters that have appeared regularly through many generations are transmitted with the greatest force, but at the same time numerous examples of the transmission of variations, which have occurred for the first time, make it possible for the breeder of live-stock to rely confidently on the inheritance of desirable variations and thus to supply the means for lasting improvement.

Correlation of parts.

The development of any character or set of characters is always accompanied by modifications, either desirable or undesirable, of other characters. If we develop a certain organ in a given direction to an extraordinary degree, we often, at the same time, suppress or destroy some other organ related to it. We may succeed in breeding out some worthless character, but, at the same time, breed out a useful quality. The whole animal organism is so closely interwoven that a change in one organ or set of organs is almost certain to result in a disturbance of the balance of other qualities and produce a change of other organs. Thus it is that the scientist with a single bone can reconstruct the skeleton of the original animal. Blind persons develop, to a high degree, the sense of touch. Blind Dr. Saunderson was an expert medalist and could distinguish counterfeits by touch alone. People who are color-blind often have a deficient musical ear. Darwin is authority for the statement "that black dogs with tan-colored feet almost always have a tan-colored spot on the upper and inner corner of each eye." He also states that "white cats with blue eyes are almost always deaf. If any color exists on the fur and only one eye is blue the sense of hearing is not lost."

Immense horns and coarse wool are associated. Hair and hides and horns and teeth vary together; hairless dogs are likely to be toothless. A large head is associated with large legs, coarse bones, late maturity and general coarseness of structure. Animals showing a remarkable tendency

to fatten are very often, if not always, deficient in milk production. A general leanness and angularity of structure is always associated with the highest yielding dairy cows. Nathusius states that "rich food tends to make the head of swine broader and longer, and that an insufficiency of poor food works the opposite result." It is from the knowledge of this intimate correlation of parts that the expert is able to recognize from an examination of the external form the presence of internal quality. Some practical stockmen even go so far as to say that if they can but see the head of a fattening steer they can tell whether or no he is a good feeder.

Atavism.

Atavism may be defined as heredity from ancestors beyond the parent. Synonyms for atavism are reversion, breeding back, and crying back. The characteristics of remote ancestors will from time to time appear in their descendants. Characters supposed to have been bred out and eliminated may reappear without any apparent reason. Every animal possesses all the characters of its parents as well as all those of its ancestors. Those characters which determine the form, habits and life of the individual are the dominant characters. The others are latent. Atavism, or reversion, is not a rare event resulting from peculiarly favorable conditions surrounding the individual, but it occurs frequently among crossed forms and is not rare among uncrossed races. Some of the causes which seem to favor the appearance of atavism are the change of environment and crossing. As an example of the first cause we find that when domestic animals are permitted to run wild they speedily revert to the characters of their unimproved ancestors.

Reversion of crossed forms.

Crossing seems to be one of the principal causes of the appearance of atavistic characters. Severe crossing, particularly, is the act of combining diversity of blood and has the effect of breaking up well-established characters. The frequent appearance of atavism in a pure-bred herd is an unfavorable indication. Some examples of atavism follow:

Many of our domestic breeds of cattle are descended from the wild white cattle of Great Britain. These cattle are small in size, and white, with brown or red ears. Not infrequently among our domestic breeds white calves are dropped with red ears. This is said to be especially frequent when Shorthorn and West Highland cattle are crossed. Polled cattle were originally horned. Very often calves are dropped by polled animals that have rudimentary horns. Sheep were originally black or brown, and black sheep are common in every flock. At the Michigan Agricultural College the writer at one time crossed an Essex sow and a Duroc Jersey boar. The pigs were sandy-colored, with stripes lengthwise of the body, like the old wild boar.

Inheritance of acquired characters.

An acquired character is one gained as a result of action or non-action or reaction from the environment, says Jordan. It is clearly to be distinguished from inherited qualities. The acquired character is usually a modification of some existing character or characters. Education is an acquired character. The extent of the individual acquirement of an animal measures the winning or losing in life. Lamarck held that use makes organs efficient. The needs of an animal in any given direction encourage the use of certain parts which develop accordingly. Thus, the ant-eater swallows its food whole, and has no need for teeth. As a result, the teeth have been practically lost. The deer and antelope escape from their enemies by their swiftness and their ability to run fast. The fastest running deer are therefore the fittest to survive. The absence of a need leads to the disuse, degeneration, and decay of organisms; thus, fish in caves lose their eyes.

Lamarck assumes that the individual acquirement of characters is a result of use, and also assumes without discussion the transmission of these acquired characters. This inheritance of characters so acquired has been widely attacked and extensively denied. Direct experiments to test this theory have not successfully confirmed the theory, but rather the reverse. Yet it must be remembered that Lamarck asserted that long periods of time were necessary for any noticeable transmission of characters which had been established by use or lost by disuse. Herbert Spencer is one of the most noted exponents of this theory, and he says, "change of function produces change of structure. It is a tenable hypothesis that changes of structure so produced are inherited." Perhaps the most noted experimental evidence along this line is the Brown-Sequard experiment already mentioned, in which the effects of certain mutilations seem to be transmitted from parent to offspring. [See page 38.]

Theory of natural selection.

Lamarck's theory is not sufficient to explain many phenomena. Thus, the shell of the tortoise is not the result of use. The conscious effort ascribed to animals in great need cannot be supposed to influence the development of plants, although we know that variations caused by changes in environment frequently occur in plants as well as in animals. All these changes may be accounted for on the theory of natural selection.

Plants and animals produce many times more young than survive. It is estimated that only one in one thousand survives. That one best fitted by reason of strength or intelligence will survive. This has given rise to the term "survival of the fittest." The individuals which survive as a result of this rigorous law of natural selection transmit their qualities to their descendents. However, they are never exactly transmitted. Variation is ever active; new combinations of characters continually present themselves. It must ever be remembered that the survival of the fittest does not necessarily mean the survival of the best.

Continuity of the germ plasm.

The distinguished investigator, Weismann, denied the inheritance of acquired characters. He main-

tained that recent investigations of the cell and the process of fertilization indicate clearly that the reproductive cells were entirely distinct from the body, or soma cells. The soma cells do not influence directly or indirectly the inherent transmissible characters contained in the germ substance. The germ substance of the reproductive cells of the offspring are like those of the parent except that they contain the germ qualities of both parents united. If Weismann is correct in his assumption of the complete differentiation of the germ and the soma cell, then we must be forced to accept his conclusion that no influence brought to bear on the soma can or does influence the germ. It is not always possible to conceive of the absolute stability of the germ plasm. It is admitted that any interference with the nutrition of the soma cell may likewise influence the physical character of the germ cell. In order to explain the inheritance of variations which certainly occur, it is necessary for the exponents of this theory to assume the occurrence of spontaneous variations in the germ plasm itself.

The germ plasm is highly stable. This is different, however, from saying that it is absolutely stable and unchanged by external surroundings. Among the domestic animals there are numerous examples of the apparent transmission of acquired characters. The discriminating sense of the foxhound as he distinguishes on the moist earth the fresh track of the fox, or of the bird-dog that is insensible to the fox tracks, but becomes immediately excited in the proximity of birds, is an interesting phenomenon. The Scotch collie seems, as a result of long continued breeding and training, instinctively to know how to assist in the handling of domestic animals, but is utterly foolish in its attempts to catch rats. Most terriers, on the other hand, are tremendously in earnest in their frantic efforts to tear up wooden floors or undermine buildings for the sake of securing a rat, but as stock-dogs are utterly useless. The wonderful productive capacity of the modern dairy cow, producing ten thousand, or even twenty thousand pounds of milk in one year, and the transmitting of these qualities to her offspring, are recognized facts among dairymen. Families of horses have acquired speed at the trot and transmitted this quality with considerable certainty.

Redfield's theory of dynamic development.

Recently, Casper L. Redfield is said to have discovered evidence of acquired characters in trotting horses. As a result of his investigations he has suggested the following principles: The development of any animal results from exercise. The amount of the development depends on the amount of exercise and the absolute amount of time devoted to the exercise. Thus, the age of the animal as well as his training becomes important. The transmission of the development depends on the amount of development acquired before the animal is bred and still possessed by the animal at the time of breeding. It is interesting to note that, according to this theory, development may be lost. Great age, with moderate and continuous development, may be as efficient as greater development exercised for a shorter time. Hence, very old animals having been moderately developed throughout their lifetime may be more efficient producers than younger animals intensively developed for a shorter time. However, Redfield holds that animals are male and female and each life is divided into a young, sexually immature stage and an old, sexually mature stage. During the sexually immature stage the sexes are biologically alike. During the sexually mature stage they are biologically different. This difference increases with maturity. Puberty represents the beginning of sexual maturity, but during intermediate maturity the sexes are partly alike and partly unlike. The development acquired before sexual maturity is transmitted equally to both sexes. The development acquired after sexual maturity is transmitted only to the offspring of the same sex. Thus stallions developed young, before sexual maturity, make good sires of mares. Stallions that are developed after the sexually mature stage make good sires of stallions, but not of mares. The same principle applies to mares. This theory is founded on the study of a very large number of individual breeding horses, stallions and mares, recorded in the register book of the breed. The conclusions may not be justified by the facts presented, but the investigation is a distinct contribution to our knowledge of breeding, and should be continued.

Whether there is a direct transmission of acquired characters or not, it is certainly true that the characteristics which dominate some of the highly improved breeds of live-stock are transmitted, and the final results are the same to the practical breeder.

Controlling the sex of offspring.

From the time of Aristotle to the present day, breeders and scientists have held that the sex of offspring could be controlled by observing certain conditions. In the very earliest writings are found full directions for producing animals of the desired sex. Even at the present time there are many practical breeders who believe that they can control at least a majority of the sex of offspring. A brief statement of some of the theories regarding the control of sex follows:

(1) It was maintained earlier that the right ovary and testicle produce males, while the left ovary and testicle produce females. This has since been found by accurate experiment to have no foundation in fact.

(2) The sex of the offspring depends on the development or maturity of the ovum at the time of fertilization. If fertilization takes place early in the heat the offspring will be a female; if in the last part of the heat, a male. This theory is widely held by practical men and frequently practiced. It is very questionable whether this method is of any value.

(3) It is asserted that each alternate ovum will be of the same sex. This is called the Stuyvesant theory. In practice, if an animal has male offspring and it is desired to produce a female offspring, she

is bred the first time she comes in heat. This theory, as the others mentioned, is not founded on carefully recorded scientific investigations.

(4) It is said that careful and continuous selection of breeding animals known to produce one sex mainly, will have some influence in determining the sex of offspring.

(5) A theory that has considerable merit and some statistical evidence supporting it is that the sex of the offspring will correspond to the personal preponderance in strength, vigor and age of one parent over the other.

(6) The kind of nutrition influences the development of sex, especially in the lower forms of organic life.

In the present state of our knowledge, it is safe to conclude that it is not practicable to attempt to control the sex among the mammalian animals.

Pre-natal influences.

It is a popular belief that the mind of the pregnant female is capable of receiving impressions in such a way as to mark the offspring. The opinion rests on a large number of recorded instances of apparent relation between mental impressions of the female and malformations of the offspring. Most of the examples brought forward to illustrate the power of mental impressions are negative in character. That mental impressions or the result of extreme nervous shocks may influence unborn young is generally admitted, but that the specific influence causing the shock is registered in the characteristics of the offspring is exceedingly doubtful. Extreme nervous shock or fright may cause arrested development, and the effects of arrested development are seen in hairlip, cleft palate, fissures of the body, loss of fingers and toes and even of the legs and arms. But these are also the most frequent examples submitted to illustrate the workings of pre-natal influences.

It is possible that habits of the mind long continued may affect the offspring. The subject is of little interest to the breeder of domestic animals. In general, it should be the constant effort of the breeder to surround the pregnant animals with normal conditions of quiet and to remove from them all causes which might produce an extreme nervous shock.

Telegony.

It is thought by some that the influence of the male is not limited to his immediate offspring but may extend to other later offspring, from other males. It sometimes happens that the offspring of the female resembles not its own sire, but some male bred to the mother at a previous time. This tendency is noted particularly among quadrupeds. An example is the Earl of Morton mare, a seven-eighths Arabian, that in the year 1815 produced a hybrid colt from the quagga; afterwards she produced in succession three colts from a pure-bred black Arabian stallion, and each time gave birth to a foal marked with stripes on the neck,

Fig. 39. The mother of this two-year filly had ten mule colts in succession before the birth of this filly. She exhibits not the slightest evidences of telegony. (Owned by Thomas Dinkle, Woodlandville, Mo.)

body, and limbs, and having a dun color and short, bristly mane like the quagga. This case is perhaps the more remarkable, because the Arabian is never known to show striped markings of the body, and the mane is invariably soft and silky and lies flat on the neck. A similar case is recorded by Harvey, in which a female was coupled with a zebra, and afterwards bred to pure-bred stallions. The first two foals to stallions possessed many of the characters of the zebra. Alexander Morrison, in 1843, bred a Clydesdale mare to a jack, the result being a mule. The next foal was by a stallion, but resembled a mule, having ears nine and one-half inches long, girth less than six feet, and height sixteen hands. The hoofs were long and narrow, and the tail thin and scanty. Dr. Miles bred a Chester White sow to an Essex boar, producing black and white pigs. She was next bred to a pure white Suffolk boar, but produced some pigs more than one-half black. Many of the examples supposed to be cases of telegony can be easily explained by the occurrence of rever-

sion, or atavism. Bulman says, although in most cases the effect is due to reversion, yet there are a few cases in which the effect is telegonic. The experiments of Ewart at Edinburgh have not given definite evidence of the existence of telegony.

If telegony occurs at all it is a rare event. It is somewhat difficult to determine by direct investigation the truth or falsity of the theory of telegony. If such influence does exist, it must undoubtedly result from the action of the spermatozoa on the immature eggs not yet ripened and expelled from the ovary. Assuming that telegony is a possibility, the authorities agree that it is of such rare occurrence as to be of little interest to the breeder of domestic animals. It occurs so rarely that the practical breeder may with safety assume its non-existence.

Cross-breeding.

Strictly speaking, the term crossing signifies the union of distinct species. More recently the term has come to be applied much more generally. As now used, it may refer to a union of different breeds or races, or even the breeding together of different strains or families within the same breed. The generally recognized results of crossing are increased fertility, increased size, and the general restoration of the constitution, vigor and thrift of animals. That crossing does increase the fertility of domestic animals cannot be denied. Many individuals are infertile with others of their own species, but will be readily bred with individuals from another species. A mare infertile with a stallion will often conceive readily when bred to a jack. It has been known to botanists that some plants are wholly infertile unless pollenized by other individuals. The experience of a large number of practical breeders demonstrates clearly that animals carefully selected and closely bred through many generations may become weak in constitution. These animals may be restored to their original vigor and thrift by crossing. Crossing for general improvement is often attended with disappointment. The inexperienced breeder is attracted with the idea that by uniting the best individuals of widely varying types we may secure all the good qualities of both types in one individual. Such a desirable result is seldom realized. The effect of crossing seems to be to break up the established type and to destroy the prepotency of the breed. The cross-bred animal is the seat of conflicting and often antagonistic characters. He is unstable. The result of the cross will always possess a tendency to revert to one of the original parent forms. Crossing for improvement is uncertain. Recent investigations in connection with Mendel's law of heredity indicate that under certain circumstances crossing may be utilized for improving some of the characteristics of the animal without sacrificing the dominant and desirable qualities.

The result of moderate crossing is often to increase considerably the vigor, thrift and fertility of the offspring. Thus, in practice, breeders frequently cross a pure-bred or a high grade female of one breed to a male of another breed of similar type. Thus, the Poland-China and the Berkshire, or the Poland-China and Duroc-Jersey, are often crossed for the production of market hogs. So, the Shorthorn, Angus, and Hereford breeds of cattle are intercrossed, the result being a very desirable class of feeding cattle. The first cross in all of these cases is generally highly satisfactory. If, however, these cross-bred animals are retained for breeding, the later results are often if not always disappointing.

Grading.

Crossing must not be confused with the practice of grading. Grading is the breeding of unimproved females to the males of well-established improved breeds. The offspring are again bred to males of the same breed, and this is continued through many generations. This practice is to be highly recommended and invariably results in success.

Inbreeding.

Inbreeding may be defined as the breeding together of close relations. Terms that are used synonomously with inbreeding are close-breeding, inter-breeding, consanguineous breeding, and incestuous breeding. It is the extreme limit of pure breeding. Some authors have attempted to limit the designation of this term to all relationship closer than second cousins. The general use of the term now, however, is not limited, and it is perhaps impossible for us to define the term more accurately than is done above. Inbreeding is common among wild animals and has been widely practiced by the breeders of domestic animals. It has been recognized from the earliest times as one of the quickest methods of fixing desirable qualities. Thus, in practice, when a marked variation occurs that is unique and found only in one individual it is natural and logical for the breeder to mate this animal with its nearest relative possessing the same characters. Thus, the sire is often mated with his own offspring.

While there is universal agreement regarding the great value of inbreeding in quickly fixing desirable variation, there is some difference of opinion as to other results which sometimes occur. There are some evils which follow inbreeding. The most common undesirable results are diminished size, weakened constitution and impaired fecundity. Of these bad results the most frequent and earliest to be observed is the loss of fecundity. Darwin mentions Lord Western as having imported a Neapolitan boar and sow. He bred in-and-in for many generations "until the breed was in danger of becoming extinct, a sure result of in-and-inbreeding." He cites also the case of J. Wright who bred "a boar with daughter, grand-daughter, and great-grand-daughter for several generations, and the result was that in many instances the offspring failed to breed, in others they produced few young that lived. The last two sows produced by this long course of inbreeding, conceived when sent to other boars and bore several litters of healthy pigs." The last litter consisted of but one pig.

The practice of inbreeding was common with the famous Bakewell in improving Longhorn cattle. Thomas Bates, the great breeder of Shorthorns, also practiced inbreeding freely. The procreative powers of both these breeds finally became greatly impaired by continuing this practice.

At the same time some other breeders have succeeded in practicing this method for many generations without serious harm to the reproductive functions. N. H. Gentry, of Sedalia, Missouri, one of the greatest modern breeders of Berkshires, has not gone outside of his own herd since 1875, for breeding stock. After his long experience he says, "I have never been able to detect any evil effects of inbreeding in my herd."

From these conflicting results it is not easy for us to harmonize the facts presented. In general, there are two beliefs regarding inbreeding. Certain breeders hold that evil from inbreeding is an accidental result and may be prevented by skillful selection. Those who hold to this belief maintain that no evil comes from inbreeding which cannot be easily explained by the laws of heredity and which may not be prevented by intelligent selection. Bad qualities are as readily transmitted as good qualities, and if animals possessing undesirable characters are closely bred these defects will be intensified. It is admitted that close-breeding is a quick method of securing desirable qualities, but it is equally certain to develop and encourage undesirable tendencies to evil which may be present in the blood. Inbreeding presupposes the most careful and intelligent selection to prevent and weed out the undesirable qualities. In the hands of a skillful, intelligent breeder, inbreeding is a powerful means to an end. For the ignorant and careless stockman it is almost sure to result in failure.

There are others who hold that evil is a necessary result of inbreeding. These persons think with Darwin that "nature abhors self-fertilization." It is necessary, in all forms of life, that there be some sort of union between distinct individuals before reproduction can take place. As in-and-inbreeding tends to identity of blood and characters, it is opposed to reproduction of the highest form.

Line-breeding.

Closely related to inbreeding is the practice known among breeders as line-breeding. This method of breeding relates to the union of animals more or less closely related. The advocates of line-breeding insist that crossing, even in the slightest degree, tends to break up or scatter the more or less artificial qualities of our highly improved breeds. The result of this practice will interfere, therefore, in a measure, with the prepotency of the animal. By mating only animals belonging to the same breed and even members of the same family, this tendency is prevented. The facts mentioned in connection with the discussions of crossing and inbreeding apply to this method of improvement. In general, line-breeding favors the fixing of characters, but may result in too great refinement and weakness of constitution.

Pedigree versus individual excellence.

The term pedigree is used to designate the ancestral history of an animal. In the popular mind it is often conceived as a written record of the names appearing in the ancestry of an individual. The term "pedigreed animals" is sometimes used to mean animals registered in some recognized book of record. The pedigree is a record of the ancestors of the animal, and should also be a guarantee of heredity. Pedigree is not a guarantee of quality and is not necessarily of value. Every animal has a pedigree. A good pedigree is one in which the ancestors of the individual have all been notable for possessing in a high degree the desirable qualities of the breed. A good pedigree of a Jersey cow, for example, is one in which every cow recorded among her ancestors has been a high-producing animal, and in which every bull mentioned has been the sire of a notable number of high-producing females. The trotting horse has a good pedigree when the sires and dams in his ancestry have all been fast individuals. The question is often asked, which is better, to select an animal with a good pedigree, but himself, not a good individual, or to select an animal without a pedigree, but a good individual? There is but one answer to this question. Neither animal should be selected. The inferior animal with a pedigree does not have a good pedigree. Otherwise he would have possessed individual excellence. The animal without a pedigree, but of good individual character, offers no assurance that his characters will be transmitted, and as a breeding animal should therefore be shunned. The whole law of heredity compels attention to pedigree, and the great principle of selection demands the closest attention to individual excellence. It must not be forgotten in this connection that the value of a pedigree depends largely on the honesty of the breeders who have owned the ancestors.

Literature.

Much information on reproduution and breeding is to be found scattered through literature. Some of the more specific references are here given: Miles, Stock Breeding; Plumb, Types and Breeds of Farm Animals; Keller, Verebungslehre und Tierzucht; Wilchens, Form und Leben Landwirthschaftlichen Hausthiere; Cornevin, Traité de Zoötechnie; Müller, Landwirtschaftliche Tierproduktionslehre; Darwin, Animals and Plants Under Domestication; Smith, Physiology of the Domestic Animals; Mills, Animal Physiology; Weismann, The Germ Plasm; Ribot, Heredity; Vernon, Variation in Animals and Plants; Hugo de Vries, Species and Varieties: Their Origin by Mutation; United States Department of Agriculture, Diseases of the Horse; Low, The Domesticated Animals; Morgan, Evolution and Adaptation; Ewart, The Penycuik Experiments; Redfield, Breeding the Trotter; Craig, Judging Live-Stock; Shaw, Animal Breeding and the Study of Breeds (two books); Wilson, The Cell and Development and Inheritance; Hertwig, The Cell; Huth, The Marriage of Near Kin; Davenport, The Principles of Breeding (1907).

ANIMAL TYPES AND SCORE-CARDS

By *Frederick B. Mumford*

The long-continued selection of the domestic animals by man has resulted in the development of certain distinct types, each of which is peculiarly adapted to supply some human need. Thus, among horses are the draft, coach, roadster and saddle types; among cattle, beef, dual-purpose and dairy types; among sheep, the wool and mutton types; hogs, the bacon and fat hog types. There are many modifications of the types here mentioned, but these are distinctive and sufficiently general to include

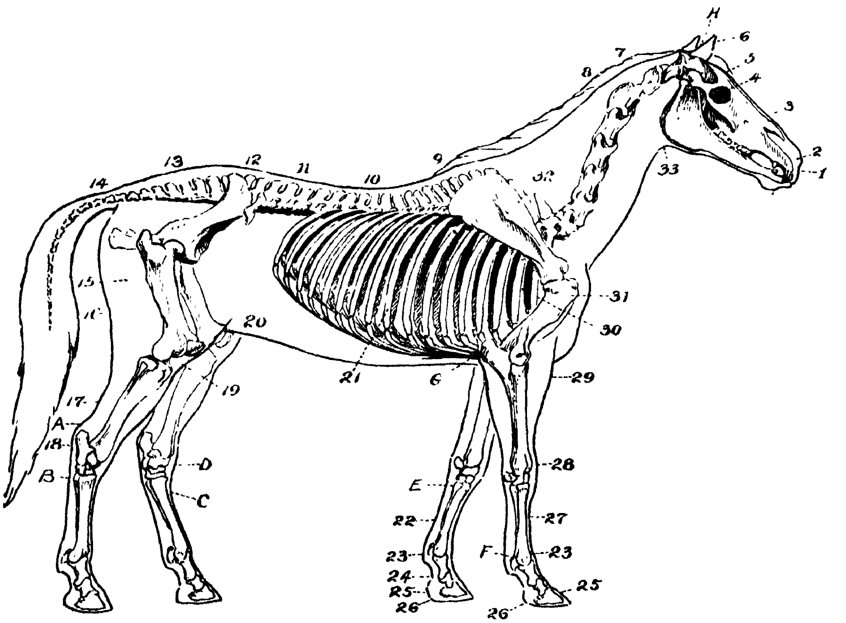


Fig. 40. Parts of the horse. 1, Muzzle; 2, nostrils; 3, face; 4, eye; 5, forehead; 6, ear. 7, neck; 8, crest; 9, withers; 10, back; 11, loin; 12, hip; 13, croup, 14, tail; 15, thigh; 16, quarter; 17, gaskin or lower thigh; 18, hock; 19, stifle; 20, flank, 21, ribs; 22, tendons; 23, fetlocks; 24, pastern; 25, foot; 26, heel of foot; 27, canon; 28, knee; 29, forearm; 30, chest; 31, arm; 32, shoulder; 33, throatlatch; A, thoroughpin; B, curb; C, bog and blood spavin; D, bone spavin; E, splint; F, windgall; G, cappel elbow; H, poll evil.

the important breeds of the domestic animals. The conformation of the different classes of animals and of the individual breeds is considered under the discussion of the animals in Part III; but the general subject of score-cards may well be considered together for purposes of comparison, and the subject naturally relates itself to breeding, which we have just considered.

I. Horse types (Figs. 40–44).

Draft horse.—This is the heaviest and largest representative of the horse tribe. The demand for this class of horses is principally from the great cities, where the ability to pull heavy loads is a first requirement. The general form is massive, powerful, low-down, blocky and compact. The value of this type, other things being equal, is directly proportional to its weight. This is illustrated by Craig in the following comparison of the average price of draft horses on the Chicago market during the year 1903:

Average weight	Average price
1400 pounds	$155 87
1450 pounds	159 15
1500 pounds	169 15
1550 pounds	176 56
1600 pounds	176 62
1650 pounds	208 64
1700 pounds	212 89
1750 pounds	236 14
1800 pounds	258 33

The quality of the draft horse is indicated by the bone and hair. The bone should be large, strong, dense and firm, and the tendons sharply defined and prominent. The fineness and silkiness of the hair, especially of the "feather" or hair on the fetlocks, is indicative of a good bone. Below the knee and hock the cannon bone should be flat. It is not to be expected that the draft horse will develop speed, but he should exhibit a bold, free and regular gait at the walk or trot. A paddling or waddling gait is undesirable.

The detailed examination of a draft horse is greatly aided by the use of a score-card. The following score-card[1] used at the University of Missouri indicates the desirable characters to be sought for in the draft horse.

It must be clearly remembered that it is not possible to arrange the valuable qualities of an animal according to any mathematical formula. The score-card, however, does attempt to designate the relative values to be placed on the development of the individual qualities of the animal. The numbers placed opposite each part or quality may be considered as percentage values and represent, therefore, the relative importance ascribed by expert judges and breeders of live-stock to the valuable qualities possessed by the various types of domestic animals. The expert judge never uses a score-card in show-yard judging, but it has been found to be an exceedingly valuable method of teaching and of learning elements of live-stock-judging. When one has scored a number of animals carefully according to a given score-card, he should have good judgment as to the values of the different "points."

[1] The author is indebted to his associate, E. B. Forbes, for suggestions for score-cards accompanying this article.

Draft Horse Score-Card

Class, Gelding

GENERAL CHARACTERS

Form.—Broad, massive, blocky, low-down, compact and symmetrical. Scale large for the age.

Quality.—General refinement of clean-cut and symmetrical features; bone clean, large and strong; skin and hair fine; tendons clean, sharply defined, and prominent.

Constitution.—Generous and symmetrical development; lively carriage; ample heart-girth, capacity of barrel and depth of flanks; eyes, full, bright and clear; nostrils large and flexible; absence of grossness or of undue refinement.

Scale of Points	Perfect score
1. **Height,** estimated ______ hands; corrected ______ hands.	
2. **Weight,** estimated ______ lbs.; corrected lbs.; score according to age and condition . . .	10
3. **Action,** walk: rapid, springy, regular, straight; trot: free, balanced, straight	15
4. **Temperament,** energetic, tractable	3
5. **Head,** proper proportionate size; well carried; profile straight	1
6. **Muzzle,** neat; nostrils large, flexible; lips thin, even, firm	1
7. **Eyes,** bright, clear, full, both same color . . .	1
8. **Forehead,** broad, full	1
9. **Ears,** medium size, well carried	1
10. **Lower jaw,** angles wide, well muscled	1
11. **Neck,** well muscled, arched; throat-latch fine; wind-pipe large	2
12. **Shoulder,** moderately sloping, smooth, snug, extending into back	3
13. **Arm,** short, strongly muscled, thrown back . .	1
14. **Forearm,** long, wide, clean, heavily muscled . .	2
15. **Knees,** straight, wide, deep, strong, clean . . .	2
16. **Fore cannons,** short, wide, clean; tendons clean, well defined, prominent	2
17. **Fetlocks,** wide, straight, strong, clean	1
18. **Pasterns,** moderately sloping; strong, clean . .	3
19. **Fore-feet,** large, even size; sound; horn dense, waxy; soles concave; bars strong, full; frogs large, elastic; heels wide, one-half length of toe, vertical to ground	8
20. **Chest,** deep, wide; breast bone low; girth large .	2
21. **Ribs,** deep, well sprung; closely ribbed to hip .	2
22. **Back,** broad, short, strong, muscular	2
23. **Loins,** short, wide, thickly muscled	2
24. **Barrel,** deep, flanks full	2
25. **Hips,** broad, smooth, level, well muscled	2
26. **Croup,** wide, heavily muscled, not too drooping .	2
27. **Thighs,** deep, broad, muscular	3
28. **Quarters,** plump with muscle, deep	2

Fig. 41. The English shire. A good draft type.

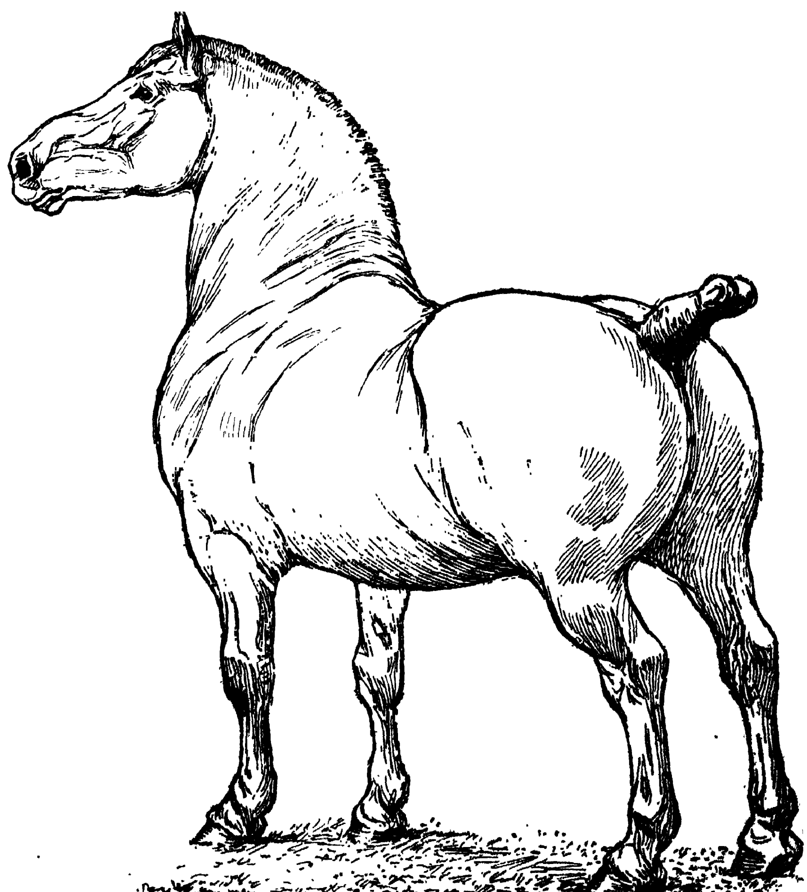


Fig. 42. A draft horse type. "Pink," twice champion at Chicago.

SCALE OF POINTS, continued	Perfect score
29. **Stifles,** large, strong, muscular, clean	2
30. **Gaskins,** long, wide, clean heavily muscled	2
31. **Hocks,** large, strong, wide, deep, clean, well set	8
32. **Hind cannons,** short, wide, clean; tendons clean, well defined	2
33. **Fetlocks,** wide, straight, strong, clean	1
34. **Pasterns,** moderately sloping, strong, clean	2
35. **Hind feet,** large, even size; sound; horn dense, waxy; soles concave; bars strong, full; frogs large, elastic; heels wide, one-half length of toe, vertical to ground	6
Total	100

the mane and tail is fine and of a silky texture. Action and speed are of prime importance and are given great prominence in judging this class of horses. The action should be prompt, spirited, straight and regular. The legs and feet are of first importance in determining the durability of these horses, and hence it goes without saying that these parts should be free from any unsoundness. The legs should possess strong, dense and flat bone. The tendons and veins stand out prominently and fleshiness or inclination to puffiness should be severely criticized. The special type of light horses which are valued for special purposes are the coach or carriage horse, the American trotter or roadster, the Thoroughbred or running horse, and the American saddle horse.

The coach horse is the largest representative of the light horse type. He was originally developed for pulling heavy coaches at a good speed. He is still well adapted for work on the heavy carriages of Europe and of the large cities of this country. The characteristics of most importance are symmetry and good action, about sixteen hands high, smooth and symmetrical in conformation and graceful carriage.

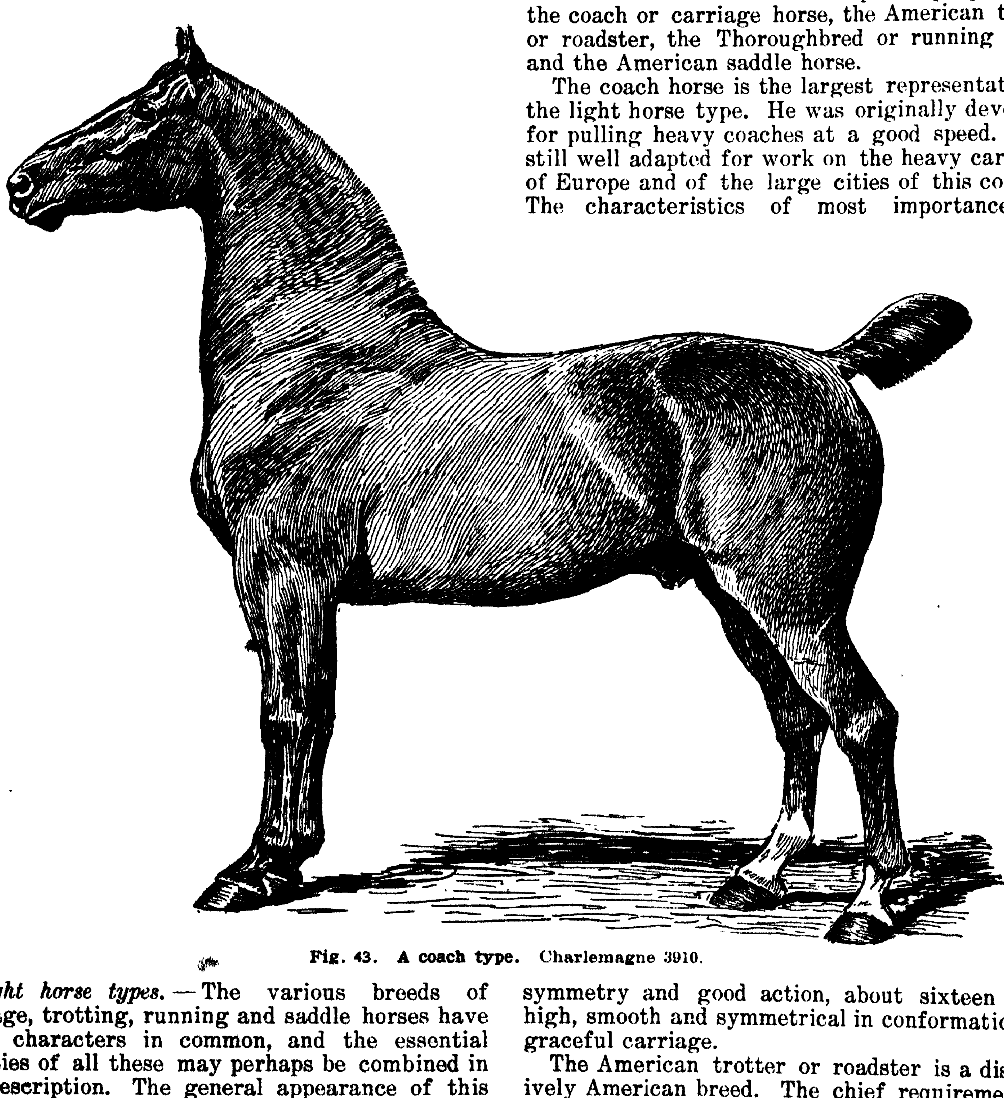


Fig. 43. A coach type. Charlemagne 3910.

Light horse types. — The various breeds of carriage, trotting, running and saddle horses have many characters in common, and the essential qualities of all these may perhaps be combined in one description. The general appearance of this type is lean, lithe, symmetrical and muscular. The whole aspect is one of extreme nervous energy and power. The back is short and strong, and the legs relatively long as compared with the draft type. The quality is indicated by extreme refinement, clean-cut features, straight and lean. The hair of

The American trotter or roadster is a distinctively American breed. The chief requirements of this class are stamina and speed. The best representatives are $15\frac{1}{4}$ to $15\frac{3}{4}$ hands high and weigh 1,000 to 1,100 pounds. The general form is one of leanness and angularity. The action is less showy, but straight, true and long-reaching. The long stride of this class is characteristic and accounts

for much of the ability of this type to cover the ground rapidly.

The Thoroughbred or running horse was developed by the English largely for the sport of racing. The characteristics described above as belonging to the whole class of light horses are intensified in every respect in the Thoroughbred.

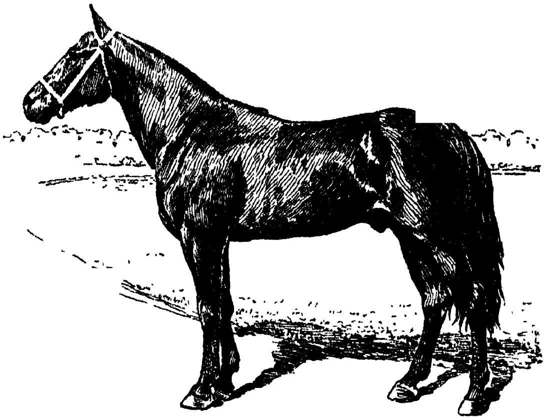


Fig. 44. Trotting horse. Directum. Owned by M. W. Savage.

He exhibits the highest possible development of nervous energy, sinewy and muscular proportions and densest bone. His evolution has been in the direction of the greatest possible speed and endurance at the running gait. He is small in size and represents the extreme of quality. He has been used largely in the improvement of other light horse breeds.

The American saddle horse has been justly called the most beautiful modern breed. His graceful form and smooth frictionless action are remarkable examples of the results of skillful breeding. As compared with the light horses the saddle horse approaches the Thoroughbred in form, but has a much longer neck and an easier, more graceful movement. The peculiarity of this breed is the facility with which it may be trained to go several distinct gaits. These gaits are the rack, or single foot, the running walk, the straight walk, trot and canter.

The score-card which is here given is an attempt to describe the essential characteristics of the light horse type in one score-card.

Light Horse Score-Card

Class, Gelding

GENERAL CHARACTERS

Form.—Light, lean, lithe and muscular; long-legged, short in back; having general appearance indicative of extreme activity.

Quality.—Extreme refinement of symmetrical and clean-cut features, showing every requirement of strength, endurance, style and grace; skin thin and pliable, showing veins plainly; hair fine; mane and tail fine and long; bone possessing plenty of substance but great refinement; tendons clean, strong and sharply defined.

Constitution.—Generous and symmetrical development; an expression of great nervous energy; action spirited; heart-girth large; floor of chest full; barrel well rounded and moderately deep; hind flanks properly developed; eyes full, bright and clear; nostrils large; bone possessing abundant substance as well as refinement.

Scale of Points	Pefect score
1. **Weight,** ______ lbs.; corrected ______ lbs.	
2. **Height,** ______ hands; corrected ______ hands . .	2
3. **Action,** walk: long, fast, elastic, straight and regular; trot: rapid, regular, straight . . .	15
4. **Temperament,** spirited, energetic and tractable.	5
5. **Skin,** thin, pliable, showing veins plainly; coat fine, soft, bright	3
6. **Head,** correct proportionate size, well carried; features clean cut; profile straight	2
7. **Muzzle,** neat, nostrils large, flexible; lips, thin, firm and even	1
8. **Eyes,** full, bright, clear, same color	2
9. **Forehead,** broad and full	2
10. **Ears,** medium size, pointed, well carried, alert .	1
11. **Lower jaw,** angles wide, space clean, well muscled	1
12. **Neck,** well muscled, arched, throatlatch fine; windpipe large	2
13. **Shoulder,** long, sloping, smooth, extending into back	3
14. **Arm,** short, strong, well muscled, thrown back .	1
15. **Forearm,** long, wide, clean, well muscled . . .	2
16. **Knees,** straight, wide, deep, strong, clean, strongly supported	4
17. **Cannons,** short, clean, wide; tendons large, clean and prominent	2
18. **Fetlocks,** wide, straight, strong, clean	1
19. **Pasterns,** long, sloping, strong, clean	3
20. **Fore feet,** medium size, even and sound; horn dense and waxy; soles concave; bars strong and full; frogs large and elastic; heels wide, one-half length of toe; vertical to ground .	6
21. **Withers,** high, extending well into back . . .	1
22. **Chest,** deep, low, girth large	3
23. **Ribs,** deep, well sprung, closely coupled	2
24. **Back,** short, broad, strong, muscular	2
25. **Loins,** short, broad, thickly muscled	2
26. **Barrel,** long in under line; flanks well let down .	1
27. **Hips,** smooth, wide and level	2
28. **Croup,** long, wide, muscular, not drooping . . .	2
29. **Tail,** attached high, well haired, well carried . .	1
30. **Thighs,** deep, broad, strong, muscular	3
31. **Quarters,** deep, plump with muscle	1
32. **Stifles,** strong, clean, muscular	2
33. **Gaskins,** long, wide, muscular	3
34. **Hocks,** large, strong, wide, deep, clean, well set.	7
35. **Cannons,** short, clean, wide; tendons large, clean and prominent	2
36. **Fetlocks,** wide, straight, strong and clean . .	1
37. **Pasterns,** strong, sloping, springy, clean . . .	3
38. **Hind feet,** medium size, even, sound; horn dense, waxy; soles concave; bars strong, full; frogs large, elastic; heels wide	4
Total	100

II. Cattle types (Figs. 45–49).

The domestic cattle of the world are bred and improved principally for three purposes: for beef, milk and labor. Incidentally they furnish useful materials for clothing and for many of the arts. The types most common to America are the beef and dairy types. The extremes of these classes

are very distinct, but merge into one another and are then sometimes called dual-purpose cattle.

Beef type.—The cattle belonging to this type are distinguished by their ability to produce a fine quality of beef. Consumers pay a high premium for the choicest cuts of beef, and those animals which supply the largest proportion of these choice cuts are the most in demand and bring the highest prices in the cattle market. The general form of the beef animal is broad, straight, deep and compact. The top and bottom lines should be straight, the legs short, the back broad and thickly covered with flesh. The qualities most desired in the finished animal are supplied by a carcass that possesses the smallest percentage of offal or waste parts and a high percentage of edible meat. The indications of prime quality in the fat animal are firmness, yet springy consistency of the flesh, and all exposed parts of the bony skeleton well covered. Undesirable quality is indicated by a large head, coarse bone, unevenly distributed and patchy flesh. The head should be moderately fine with a broad, full and high forehead, which will suggest a well-developed nervous system and strong vitality. A clear full eye shows good health and gentle temperament. The shoulder of a good beef animal is compact and well covered with flesh, with no coarseness or angularity. The chest is broad, deep and full in every part. A well-sprung rib giving a broad back with large heart-girth gives increased room for the valuable meat cuts. The back is broad, straight and of medium length. The loin, carrying, as it does, the highest quality of flesh, is justly regarded by consumer, butcher and feeder alike as the one most important part of the entire animal. The hips are smooth and wide apart. The rump of the beef animal is long, level and wide. A full, thick and well-fleshed thigh will not be overlooked, and with such a thigh the twist will extend well down, giving the general appearance of very short legs when the animal is viewed from behind. A detailed description of the beef animal is given in the score-card following.

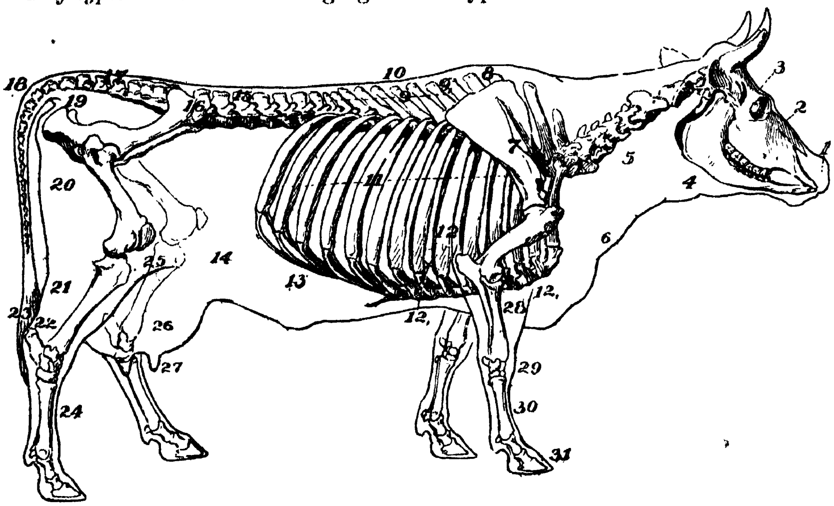


Fig. 45. Parts of the cow. 1, muzzle; 2, face; 3, forehead; 4, throat; 5, neck, 6, dewlap, 7, shoulder; 8, wethers; 9, back; 9₁, crops; 10, chine; 11, ribs; 12, fore ribs; 12₁, fore flank; 12, 12₁, chest; 13, belly; 14, flank; 15, loin; 16, hips; 17, rump; 18, setting of tail; 19, thurl or pin-bone; 20, quarter; 21, thigh; 22, hock; 23, switch; 24, leg; 25, stifle, 26, udder; 27, teat; 28, forearm; 29, knee; 30, shank; 31, hoof.

Beef Cattle Score-Card

Class, Breeding Females

GENERAL CHARACTERS

Form.—Compact, thick-set and short-legged in appearance; body deep, thick and of medium length; top line straight, under line low in flanks; scale medium to large, not greatly above average for the breed.

Quality.—General refinement of symmetrical and clean-cut features; breed characters pronounced; bone fine

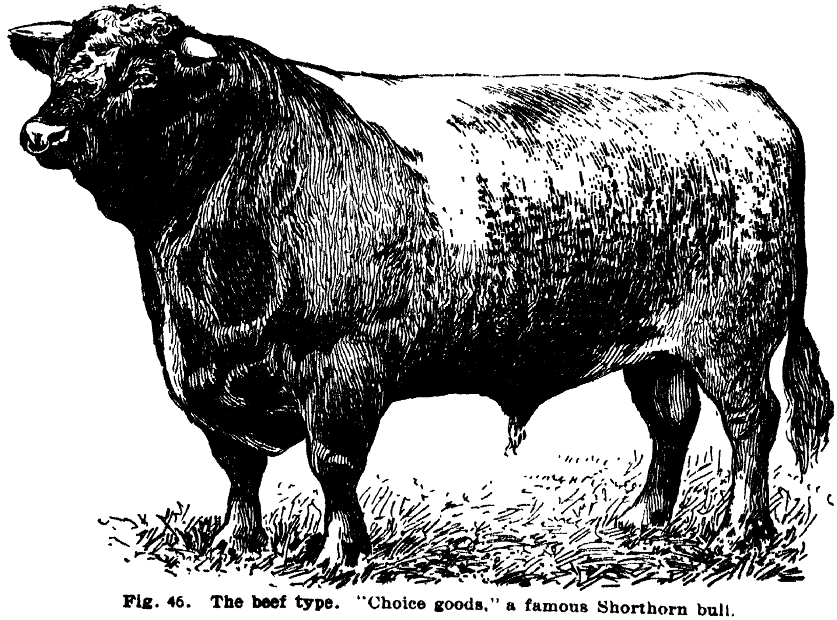


Fig. 46. The beef type. "Choice goods," a famous Shorthorn bull.

and clean; hair fine and soft; skin of not more than medium thickness; head, neck and legs short and fine, but strong.

Condition.—Great wealth of natural flesh, as from abundant supply of best grass or other roughage, but not excessively fat; flesh firm, mellow and springy, without ties, lumps, patches or rolls, especially in the back and loin; skin loose and soft; depth and evenness of flesh consistent with degree of fatness.

Constitution.—Generous and symmetrical development; lively carriage; ample heart-girth, capacity of barrel and depth of flanks; eyes full, bright and clear; nostrils wide apart, large and open; absence of refinement to point of delicacy; skin of at least medium thickness and free from scurf; coat soft and bright.

Early maturity.—General refinement and compactness; body large, extremities small; shortness of head, neck and legs; amplitude of girth in chest, belly and flanks.

Sexuality.—Strongly marked; a general appearance of sensibility and feminine refinement of features; moderate length and great capacity in coupling; width in loin, hip-bones and pin-bones; well-developed udder and prominent milk veins; horn and coat fine; eyes expressive of mild and gentle sensitiveness.

Scale of Points	Perfect score
1. **Age,** estimated ___; corrected ___	
2. **Weight,** estimated ___ lbs.; corrected ___ lbs., score according to age and condition	5
3. **Skin,** of medium thickness, loose, soft, elastic, free from scurf	3
4. **Hair,** fine, soft, thick; color and markings according to breed	3
5. **Temperament,** quiet, mild and contented	3
6. **Muzzle,** mouth large, lips thin, nostrils large, open and wide apart	2
7. **Face,** fine, moderately short and broad	2
8. **Forehead,** full, broad and square	2
9. **Eyes,** full, bright, clear and placid	1
10. **Jaws,** wide, deep and strong	1
11. **Horns,** medium to small, fine texture, shape and color according to breed	1
12. **Ears,** medium size, fine texture	1
13. **Neck,** thick, short, curving smoothly into shoulders and brisket; throat clean; dewlap slight	3
14. **Shoulders,** compact, snug, smooth, well fleshed	5
15. **Fore-legs,** short, straight, strong; arm full; bone fine and clean; feet small, strong, even; hoofs dense	3
16. **Brisket,** moderately projecting, neat and broad	1
17. **Chest,** full, deep, wide; heart-girth large; fore flanks deep and full	10
18. **Barrel,** capacious, medium length	5
19. **Crops,** moderately full, flesh thick and even	5
20. **Ribs,** long, closely set, well sprung, extending fairly well back; back broad and straight; flesh thick and even	10
21. **Loin,** broad, straight; flesh thick and even	6
22. **Hips,** wide but not prominent, capable of being smoothly covered	3
23. **Rump,** long, level, wide; tail-head smooth; flesh thick and even	5
24. **Pin-bones,** far apart, not prominent	2
25. **Tail,** tapering, bone fine	1
26. **Thighs and twist,** full, muscled well down to hocks	6
27. **Hind-legs,** short, straight, strong; bone fine and clean, feet small, strong, even; hoofs dense	3
28. **Hind flank,** low, full, thick	3
29. **Udder,** large, shapely, evenly quartered, not fleshy; teats uniform, medium sized, squarely placed, milk veins prominent	5
Total	100

Beef Cattle Score-Card

Class, Breeding Bulls

GENERAL CHARACTERS

Form.—Compact, thick-set, and short-legged in appearance; body deep, thick and of medium length; top line straight, under line low in flanks; fore quarters heavier than in a cow; scale medium to large, not greatly above average for the breed.

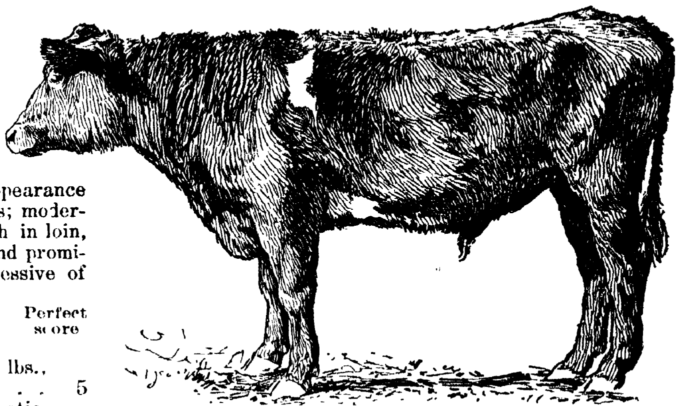


Fig. 47. A poor beef type. Light quarters and narrow frame give a light yield of carcass and a proportionately large amount of the cheap cuts.

Quality.—Features clean cut and symmetrical, showing great strength without grossness; breed characters pronounced; bone strong and clean; hair moderately fine and soft; skin of medium thickness; head, neck and legs short, strong and massive.

Condition.—Great wealth of natural flesh as from abundant supply of best grass or other roughage, but not excessively fat; flesh firm, mellow and springy, without ties, lumps, patches or rolls, especially in the back and loin; depth and evenness of flesh consistent with degree of fatness.

Constitution.—Generous and symmetrical development; lively carriage; ample heart-girth, capacity of barrel and depth of flanks; eye full, bright and clear; nostrils wide apart, large and open; absence of grossness or of undue refinement.

Early maturity.—Compactness and strength with as much refinement as is consistent with masculinity; body large, extremities small; shortness of head, neck and legs; amplitude of girth in chest, belly and flanks.

Sexuality.—Strongly marked; a majestic carriage and general appearance of masculine power and aggressiveness; great strength without grossness in head, neck and legs; chest well developed; shoulders very strong; well-developed sexual organs.

Scale of Points	Perfect score
1. **Age,** estimated ___; corrected ___	
2. **Weight,** estimated ___ lbs.; corrected ___ lbs.; according to age and condition	5
3. **Skin,** moderately thick, loose, soft, elastic, free from scurf	3
4. **Hair,** thick; moderately fine and soft, color and markings according to breed	3
5. **Temperament,** alert but quiet and good natured	3
6. **Muzzle,** mouth large, lips round and firm; nostrils large, open and wide apart	2
7. **Face,** short, straight, strong, full	2
8. **Forehead,** full, very broad, heavy between eyes	2
9. **Eyes,** full, bright, clear, mild	1

SCALE OF POINTS, continued	Perfect score
10. **Jaws,** wide, deep and strong	1
11. **Horns,** fine texture, strong; shape and color according to breed	1
12. **Ears,** medium size, well haired, not coarse	1
13. **Neck,** short, massive, curving strongly into shoulders and brisket; crest strong; throat clean; dewlap slight	3
14. **Shoulders,** strongly developed, compact, snug, well fleshed	5
15. **Fore-legs,** short, straight, arm full, bone strong and clean; hoofs large, strong, even and dense	3
16. **Brisket,** deep, broad, rounded, neat, moderately projecting	1
17. **Chest,** full, deep, wide; heart-girth large; fore flanks deep	10
18. **Barrel,** deep, broad, medium length	4
19. **Crops,** full and thick, straight in top line	5
20. **Ribs,** long, closely set, well sprung, extending well back; back broad and straight; flesh thick and even	10
21. **Loin,** broad, straight; flesh thick and even	6
22. **Hips,** wide, but not prominent, capable of being smoothly covered	3
23. **Rump,** long, level, wide; tail-head smooth; flesh thick and even	5
24. **Pin-bones,** far apart, not prominent	2
25. **Tail,** tapering, bone moderately fine	1
26. **Thighs,** full, wide and deep; muscled well down to hocks	4
27. **Twist,** deep and full	4
28. **Hind-legs,** short, straight, bone strong and clean; hoofs large, strong and even	3
29. **Hind flank,** full, low	4
30. **Testicles,** well developed, both present and normally placed	3
Total	100

Dairy type.—The typical dairy animal is widely different from the beef animal. The general conformation of this type is one of leanness and angularity. There is nowhere surplus fat tissue, and no matter how great the quantity of food eaten, the resulting product is finally, through the assimilating energies of the cow, manufactured into milk and butter. The ideal dairy form is

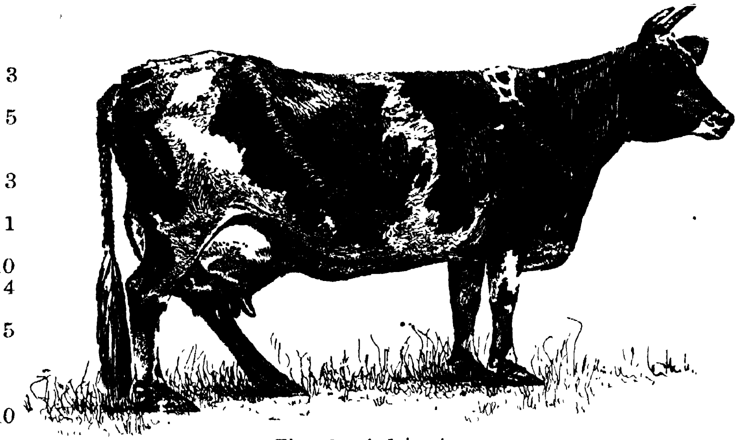


Fig. 48. A dairy type.

wedge-shaped, viewed from the front, side and above. The wedge-shape should be due primarily to the enlarged and expanded pelvic region. The head of the dairy animal should be rather long, broad at the forehead, the face somewhat dished and the nostrils large and open. A dense horn structure is desirable. The neck is long, thin and muscular, but it should be neatly attached to the shoulders. The shoulders themselves should lie reasonably close together, forming at the withers a sharp angle. The chest, while narrower than in the beef animal, should be deep and capacious. The legs, both front and behind, should be straight and be attached to the corners of the body. The back should be strong, reasonably long, and showing large backbone. The loin is broad and level, giving a good width of back. The ribs should be so arched as to extend well downward and give the animal large abdominal capacity. The hips are wide apart and prominent. The long, broad and level rump is indicative of reproductive power. The thighs are thin and muscular. The udder represents the organ of special dairy development, and should be of good size, extending well forward in front and up behind. It should be provided with four teats placed well apart and of medium size. When the milk is drawn, the udder should be left soft and pliable. A thin covering of fine silky hair over the entire udder is desirable. The milk veins, so called, extend from the udder forward and under

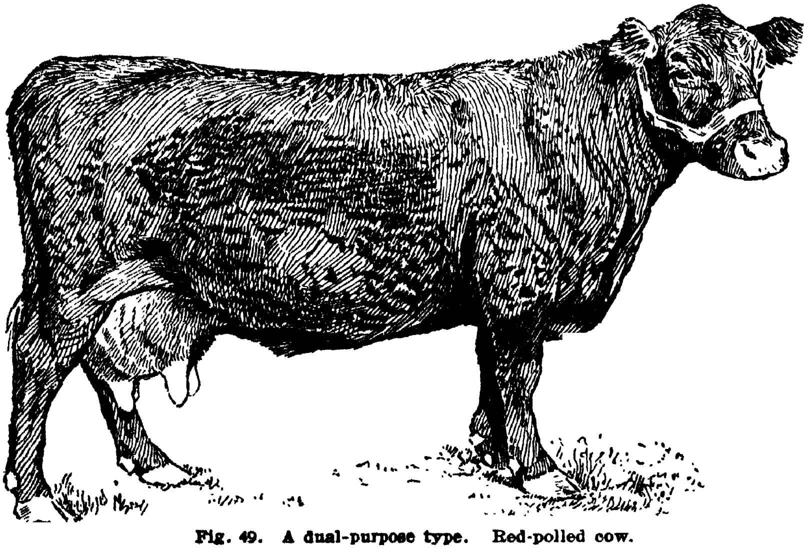


Fig. 49. A dual-purpose type. Red-polled cow.

the thorax. These should be large, tortuous and branching. The milk wells, through which these veins enter the thorax, should be large. A yellow color of the skin is considered desirable by many authorities. The score-card following gives a more detailed description of the dairy type.

Dairy Cattle Score-Card

Class, Breeding Females

GENERAL CHARACTERS

Form.—Spare, angular, moderately short-legged; barrel, capacious; hind quarters, wide and deep; scale, medium to large, not greatly above average for the breed.

Quality.—General refinement of symmetrical and clean-cut features; bone fine and clean; hair fine and soft; skin of not more than medium thickness; head, neck and legs fine and of moderate length.

Condition.—Spare, no fat apparent; skin loose and mellow.

Constitution.—Generous and symmetrical development; lively carriage; ample heart-girth, capacity of barrel and depth of flanks; eyes full, bright and clear; nostrils, wide apart, large, and open; absence of refinement and spareness to point of delicacy or emaciation; skin of medium thickness, free from scurf; coat soft and bright.

Nervous energy.—Spinal column prominent, vertebræ wide apart; forehead, high and wide; ears active; temperament alert; also the indications of constitution and quality.

Sexuality.—A general appearance of sensibility and feminine refinement of features; moderate length and great capacity in barrel, width in loin, hip-bones and pin-bones; well developed udder; horn and coat fine; eyes expressive of mild and gentle sensitiveness.

Milk-giving capacity.—Udder large, shapely, evenly quartered, free from fleshiness, extending well up behind and far forward, strongly attached; milk veins large and tortuous; milk wells large; secretions of skin abundant and yellow; also the above indications of all the other general characters.

Scale of Points	Perfect score
1. **Age,** estimated ______	
2. **Weight,** estimated lbs.; corrected ______ lbs.; score according to age and condition	2
3. **Skin,** medium fine, loose, mellow, elastic, free from scurf; secretions yellow and abundant	5
4. **Hair,** fine, soft, thick; color and markings according to breed	2
5. **Temperament,** alert, but mild and tractable	5
6. **Muzzle,** clean cut, mouth large, lips thin, nostrils large	1
7. **Face,** lean, fine, slightly dished	1
8. **Forehead,** broad, high, slightly dished	1
9. **Eyes,** full, bright, clear, mild	3
10. **Horns,** medium to small, fine texture, shape and color according to breed	1
11. **Ears,** medium size, fine texture	1
12. **Neck,** fine, spare, medium length, throat clean; dewlap light; neatly attached to head and shoulders	2
13. **Shoulders,** lean, sloping; narrow at withers, moderately wide at points	2
14. **Fore-legs,** straight, short, bone clean and fine; feet strong, hoofs dense and even	2
15. **Brisket,** light, thin	1
16. **Chest,** deep, capacious	8
17. **Barrel,** capacious, medium length	10
18. **Back,** lean, straight, medium length; vertebræ wide spaced and prominent; ribs long, broad, wide spaced, moderately well sprung	8

Scale of Points, continued	Perfect score
19. **Loin,** broad, lean, coupling roomy	3
20. **Hips,** far apart, level with back	2
21. **Rump,** lean, long, broad; pelvic arch prominent; pin-bones high, far apart	4
22. **Tail,** tapering, bone fine, length according to breed	1
23. **Thighs,** thin, incurving, twist roomy	3
24. **Hind-legs,** straight, short, bone clean and fine; feet strong; hoofs dense and even	2
25. **Udder,** large, shapely, evenly quartered, mellow, free from fleshiness, extending well up behind and far forward, strongly attached; teats uniform, well placed, of size and shape convenient for milking	20
26. **Milk veins,** large, tortuous; milk wells large.	10
Total	100

III. Sheep types (Figs. 50–54).

Sheep may be broadly classified as wool and mutton breeds. All sheep produce wool and all sheep are valuable for mutton, but with sheep, as with other classes of the domestic animals, the mutton qualities of certain breeds are highly developed, the wool being secondary. Other breeds are selected chiefly for their wool. This selection consistently for one or the other purpose has resulted in the two breeds named.

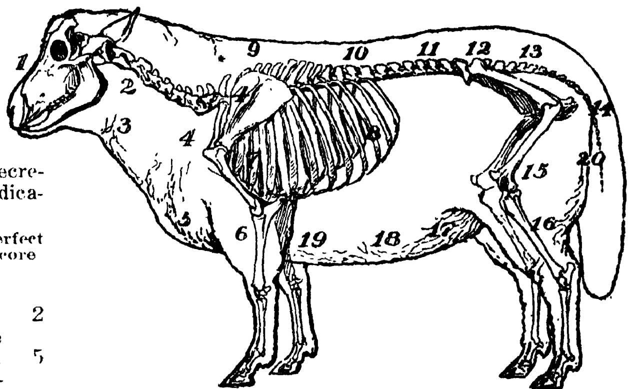


Fig. 50. Parts of the sheep. 1, head; 2, neck; 3, shoulder vein; 4, shoulder; 5, brisket; 6, foreleg; 7, chest; 8, ribs; 9, top of shoulder; 10, back; 11, loin; 12, hip; 13, rump; 14, tail; 15, giggot or leg of mutton; 16, hind leg; 17, flank; 18, belly; 19, fore flank; 20, twist.

Mutton type.—The mutton type corresponds in general form to the so-called meat type of all the domestic animals. This form is compact, thick-set low down and blocky. The body is deep, broad and of medium length. The top and bottom lines are straight. The evidences of quality are general refinement and symmetry, fine smooth bone, with short head, neck and legs. In the fat animal the carcass should be covered with deep, firm, mellow and springy flesh evenly distributed, without lumpiness or rolls. The wool should be uniformly long, dense and with some crimp. The yolk should be evenly distributed and moderately abundant. The other detailed characters for the fat mutton sheep are indicated in the following score-card, which applies to unsexed fat animals only.

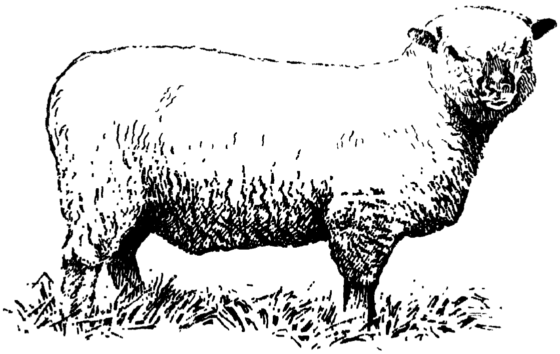


Fig. 51. The mutton type. Shropshire wether in field condition.

Mutton Sheep Score-Card

Class, Fat Wethers

GENERAL CHARACTERS

Form.—Compact, thick-set and short-legged; body deep, thick, and of medium length; top line straight; under line low in flanks; scale large for age.

Quality.—General refinement and symmetry of clean-cut features; mutton breed character pronounced; head, neck and legs short; bone fine and smooth; fleece pure and fine.

Condition.—Prime; a deep, even covering of firm, mellow and springy flesh, without lumps, patches, rolls, or undue accumulations of fat, especially in back, loin, rump, or fore flanks; neck thick; shoulder-vein full; top and points of shoulder, back-bone and loin smoothly covered, and leg of mutton deep and full.

Constitution.—Should be thoroughly healthy.

Early maturity.—General refinement and compactness; body large; extremities small; shortness of head, neck and legs; amplitude of girth in chest, belly and flanks.

Scale of Points	Perfect score
1. **Age,**	
2. **Scale,** estimated weight ___ lbs.; corrected ___ lbs.; score according to age	12
3. **Skin,** bright, clean, and free from scurf; color according to breed	1
4. **Fleece,** pure, uniformly long and dense; crimp, even and fine; quality fine; condition bright, clean and lustrous; yolk evenly distributed and moderately abundant; general character according to breed	12
5. **Muzzle,** fine, nostrils open	1
6. **Face,** short; color and covering according to breed	2
7. **Eyes,** bright and clear	2
8. **Forehead,** broad; wooled according to breed	2
9. **Ears,** fine; length, color, covering and carriage according to breed	2
10. **Neck,** short and thick, blending smoothly with shoulder	3
11. **Shoulder,** broad, compact and snug; thickly and evenly fleshed	5
12. **Fore-legs,** straight, short, arm full; bone fine and smooth; feet strong; color and covering according to breed	3
13. **Chest,** deep, broad and full; brisket wide, heart-girth large; fore flanks deep and full	5
14. **Back,** broad, straight and of medium length; ribs well sprung; thickly and evenly fleshed	10

Scale of Points, continued	Perfect score
15. **Loin,** broad and straight; thickly and evenly fleshed	10
16. **Rump,** long, level and wide; hips smooth; thickly and evenly fleshed	10
17. **Thighs,** full, fleshed low down, twist deep and full	15
18. **Belly,** not unduly large	2
19. **Hind-legs,** straight and short; bone fine and smooth; feet strong; color and covering according to breed	3
Total	100

Wool type.—The wool types of sheep are selected primarily for the quantity and quality of the wool produced. The extreme type of wool sheep has perhaps been best developed in America. This animal was selected through many years for the production of a fine quality and large relative production of wool. The type was characterized by a relatively small body perfectly covered with wool from the extremities to the belly and even to the tip of the nose. Many of the earlier specimens of this type were produced with immense folds or wrinkles which increased the surface on which wool might be grown. In more recent years, the most highly prized type of wool sheep is devoid of wrinkles, of much larger size and of stronger constitution. This type is valuable for both wool and mutton and is exceedingly popular on western ranges. The prime consideration is a long, even, and dense fleece, evenly covering the entire body. This should be supplied with an even fluid yolk; the fiber should be strong, slightly crimped and without

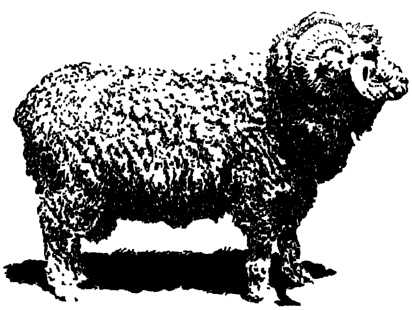


Fig. 52. American Delaine Merino in field condition.

break. A bright clean skin is indicative of a good constitution and general health.

The score-card given below indicates the essential details of both the mutton and the wool types of sheep, and indicates clearly the distinguishing differences of these two valuable types.

There is ample justification for combining on the same score-card the essential characteristics of both mutton and wool sheep. The development of the two characters of mutton production and wool growth is not incompatible, and both may be present in the same individual. It is true, however, that in improving the domestic animals it is easier to perfect one quality rather than to attempt to combine two in the development of a breed or type.

Breeding Sheep Score-Card

GENERAL CHARACTERS

Form. — Compact, thick-set and short-legged; body deep, thick and of medium length; top line straight; under line low in flanks; scale large for age.

Quality.—General refinement and symmetry of clean-cut features; breed character pronounced; head, neck and legs short; bone smooth, moderately fine in ewe, somewhat stronger in ram; fleece pure, fine in ewe, somewhat coarser in ram.

Condition.—Great wealth of natural flesh but not excessively fat; flesh firm, mellow and springy, without lumps, patches, rolls or undue accumulations of fat, especially in back, loin, rump and fore flanks; depth and evenness of flesh consistent with degree of fatness.

Constitution.—Generous and symmetrical development; ample heart-girth, capacity of barrel and depth of flanks; eyes full, bright and clear; nostrils large and open; throat free from lumps; absence of refinement to point of delicacy; skin bright; fleece bright, soft and long, crimp even, yolk moderately abundant.

Early maturity.—General refinement and compactness; body large, extremities small; shortness of head, neck and legs; amplitude of girth in chest, belly and flanks.

Sexuality.—In males: A bold, active and aggressive carriage; great strength without grossness in head, neck, legs and shoulders; well-developed sexual organs.

In females: General refinement; good development of barrel; head, neck and legs lighter and finer than in ram.

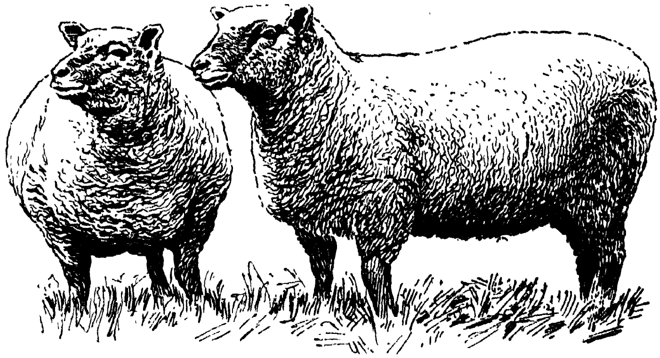


Fig. 54. An Improved Southdown sheep type.

Scale of Points	Mutton sheep Perfect score	Fine-wooled sheep Perfect score
1. **Age,** ___ ___		
2. **Scale,** estimated weight___ lbs.; corrected___ lbs.; score according to age	10	8
3. **Skin,** bright, clean and free from scurf; color according to breed	3	5
4. **Fleece,** pure, uniformly long and dense; crimp even and fine; quality fine; condition bright, clean and lustrous, yolk evenly distributed and moderately abundant; general character according to breed	15	30
5. **Muzzle,** fine in ewe, broad in ram; nostrils open	1	1
6. **Face,** short; fine in ewe, strong in ram; color and covering according to breed	5	5
7. **Eyes,** large, bright and clear	3	3
8. **Forehead,** broad in ewe, still broader in ram; wooled according to breed	3	3
9. **Ears,** fine; length, color, covering and carriage according to breed	3	3
10. **Neck,** short, blending smoothly with shoulders; especially thick in ram	3	2
11. **Shoulder,** broad, compact, snug and well fleshed	4	3
12. **Fore-legs,** straight, short, arm full, feet strong; bone smooth, fine in ewe, stronger in ram; color and covering according to breed	4	3
13. **Chest,** deep, broad and full; brisket wide; heart-girth large; fore flanks deep and full	10	10
14. **Back,** well fleshed, broad, straight and of medium length; ribs well sprung	6	4
15. **Loin,** well fleshed, broad and straight	6	4
16. **Rump,** long, level, wide and well fleshed	6	4
17. **Thighs,** full; fleshed low down; twist deep and full	10	6
18. **Body,** deep and capacious in belly and hind flanks	4	3
19. **Hind-legs,** straight and short; feet strong; bone smooth, moderately fine in ewe, strong in ram; color and covering according to breed.	4	3
Total	100	100

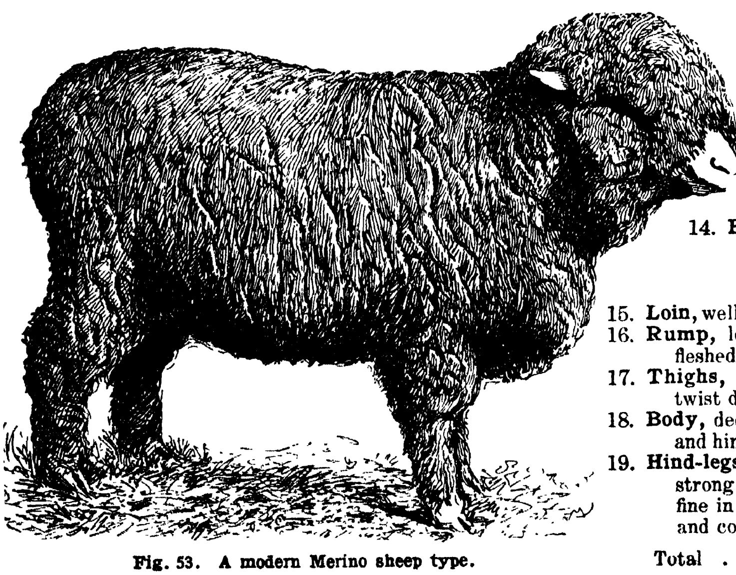


Fig. 53. A modern Merino sheep type.

IV. Swine types (Figs. 55–57).

Swine are produced exclusively for their flesh. The quality of the flesh demanded by various markets varies, and this variation in market demands has resulted in the development of certain special types of hogs. For convenience, we may divide hogs into the fat hog and bacon classes.

Fat hog type.—The fat hog type is universal throughout the corn-belt. It is the extreme development of meat form. It is distinguished by extreme compactness of form and unusually small development of bone and other waste parts. The highest-priced parts are the hams and sides, consequently in all breeds the size of the ham and of the sides is carefully considered. The excessive development of fat in the corn-fed hog is a remarkable evidence of the influence of food and selection on the domestic animals. This tendency to lay on fat has been carried to such an extreme that some individuals of these highly improved breeds are objectionable because of the extreme amount of fat which they carry when fully prepared for market. This has led to the demand for a leaner hog. Such is the so-called "bacon" hog.

The score-card here given indicates clearly the essential details in the conformation of the fat hog.

Fat Hog Score-Card

Class, Breeding Hogs

GENERAL CHARACTERS

Form.—Low-set, broad and deep; standing squarely on short and strong legs and feet; back slightly arched; body compact in male, of good length in female; under line approximately straight; scale medium to large, not greatly above average for the breed.

Quality.—General refinement of symmetrical and clean-cut features; bone clean and strong, moderately coarse in male, moderately fine in female; skin smooth; hair fine; head, neck and legs short; shields in male not unduly coarse; breed characters pronounced.

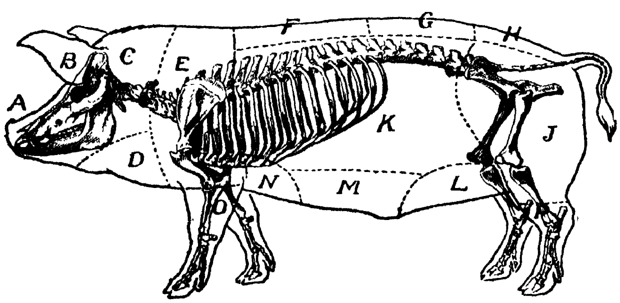


Fig. 55. Parts of the hog. *a*, snout; *b*, ear; *c*, neck; *d*, jowl; *e*, shoulder; *f*, back; *g*, loin; *h*, rump; *j*, ham; *k*, side or ribs; *l*, flank; *m*, belly; *n*, fore flank; *o*, fore leg; *p*, hind leg.

Condition.—Strongly muscled and thickly fleshed, but not excessively fat; flesh firm, mellow, even and smooth.

Constitution.—Generous and symmetrical development; lively carriage; ample heart-girth, capacity of barrel and depth of flanks; eyes full, bright and clear; coat thick, smooth and bright; absence of refinement to point of delicacy.

Sexuality.—Strongly marked. In males: Active carriage, aggressive disposition; strength without grossness in head and legs; neck arched and heavy; snout broad; shoulders strong; shields present in mature animals; well-developed sexual organs. In female: General refinement of features; good length and depth in barrel; full number of well-placed and well-developed teats present; head lighter than in boar, neck narrower behind ears; good breadth in loin, hips and rump.

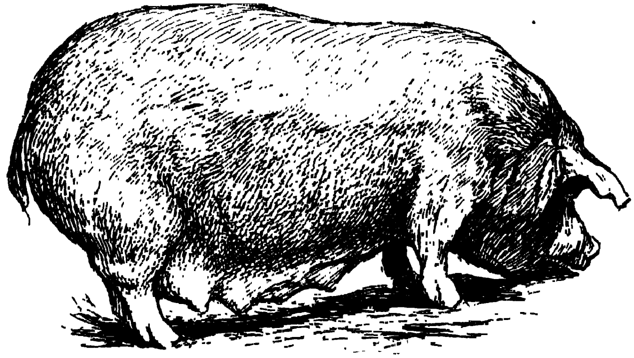


Fig. 56. A lard hog type.

Early maturity.—General refinement and compactness; body large, extremities small; shortness of head, neck and legs; amplitude of girth in chest, belly and flanks.

Scale of Points	Perfect score
1. **Age,** estimated______; corrected______.	
2. **Scale,** estimated weight______lbs; corrected ______lbs.; score according to age	6
3. **Skin,** smooth, mellow and free from scurf . . .	2
4. **Hair,** thick, bright, smooth, fine and uniformly distributed; color and markings according to breed	2
5. **Temperament,** aggressive in male; gentle and quiet in female	2
6. **Snout,** short and smooth, tapering from face to tip of nose; broad in male, finer in female .	1
7. **Face,** short, smooth, broad between eyes, dished according to breed; cheeks full; forehead high and wide	2
8. **Eyes,** full, bright, clear and not obscured by wrinkles	1
9. **Ears,** medium or small, fine in texture, neatly attached, carriage according to breed . . .	1
10. **Jowl,** full, smooth, firm and neat	2
11. **Neck,** wide, deep, short and nicely arched, blending smoothly with shoulder; in male, heavy; in female, finer behind the ears	3
12. **Shoulder,** broad, deep, full and compact; heavier in male than in female, but shields not unduly coarse	8
13. **Fore-legs,** short, straight, strong, squarely set, wide apart; pasterns short; feet strong; bone moderately coarse in male, moderately fine in female	6
14. **Chest,** deep, wide and full; breast bone advanced	8
15. **Back and loin,** broad, strong and slightly arched; moderately short in male, moderately long in female; thickly and evenly fleshed; ribs well sprung	12
16. **Sides,** deep, full and smooth	8

Scale of Points, continued	Perfect score
17. **Belly,** wide; under line approximately straight	3
18. **Udder** (female), full number of well-developed and well-placed teats. **Testicles** (male), well-developed, both present and normally placed	8
19. **Hind flank,** low	2
20. **Rump,** long, broad, gradually rounding from loin to root of tail; thickly and evenly fleshed; hips wide and smooth	6
21. **Hams,** full, deep and broad; fleshed well down to hocks	10
22. **Hind-legs,** short, straight, strong, squarely set, wide apart; pasterns short; feet strong; bone moderately coarse in male, moderately fine in female	6
23. **Tail,** tapering, medium-sized or small	1
Total	100

Bacon type.—The general form of the bacon hog is long, deep and of medium size. In every way this hog is thinner, leaner and rangier than the fat hog type. He is late in maturing but may be fed to a great weight. The bone is strong, the skin and hair fine and smooth and the whole body heavily muscled. We look especially for the development of the sides and belly in this class of hogs, as it is from this part that the bacon is secured. In other respects the characteristics of the bacon hog are not widely different from the characters especially desired in all types of domestic swine. The score-card for the bacon type follows.

Bacon Hog Score-Card

General Characters

Form.—Long, deep, smooth and of medium width; sides straight; legs short for the breed; head light; back slightly arched, under line straight; scale large for age; standard weight 170–200 pounds.

Quality.—General refinement of symmetrical and clean-cut features; bone smooth, fine and strong; skin and hair fine and smooth; head, neck and legs short for the breed; bacon hog breed character pronounced.

Condition.—Heavily muscled, moderately fat; covering firm, smooth and of uniform thickness, especially in sides and belly.

Constitution.—Should be thoroughly healthy.

Early maturity.—General refinement, especially of head, neck and legs; body large; extremities small; amplitude of girth in chest, belly and flanks.

Scale of Points	Perfect score
1. **Scale,** large for age	6
2. **Skin,** smooth and fine; color according to breed	2
3. **Hair,** abundant, fine, bright, smooth; color according to breed	1

Scale of Points, continued	Perfect score
4. **Snout,** shaped according to breed	1
5. **Face,** smooth and slightly dished	1
6. **Eyes,** full and bright; not obscured by wrinkles	1
7. **Ears,** fine in texture; shape and position according to breed	1
8. **Jowl,** light, smooth and neat	3
9. **Neck,** light, medium length	3
10. **Shoulders,** smooth, compact, free from any coarseness; moderately fat	8
11. **Fore-legs,** straight, short for the breed; bone fine, strong and smooth; pasterns upright, feet strong	3
12. **Chest,** deep; full in heart-girth	5
13. **Back and loin,** long, smooth, strong, medium and uniform in width; moderately fat	15
14. **Rump,** long, smooth, medium in width; rounding from loin to tail; moderately fat	5
15. **Hams,** firm, smoothly covered, fleshed deep and low toward hocks	10
16. **Sides,** long, smooth, deep, straight, moderately fat	20
17. **Belly,** long, smooth, straight and firm	12

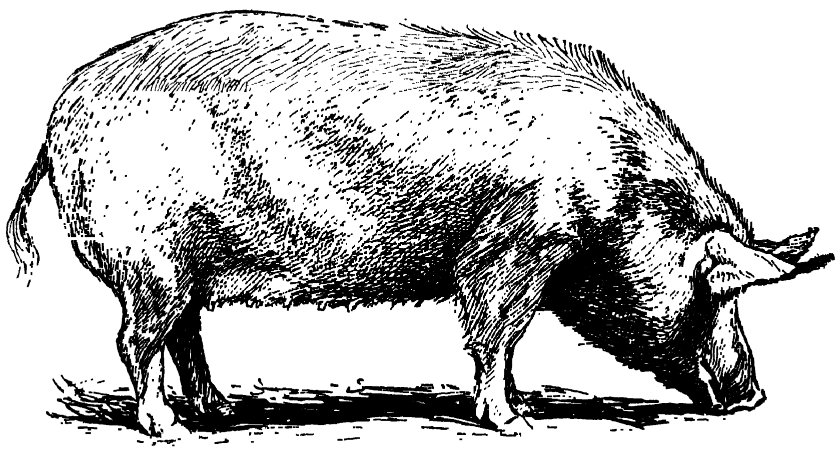


Fig. 57. A bacon hog type.

18. **Hind-legs,** straight, short for the breed; bone fine, strong and smooth, pasterns upright; feet strong	3
Total	100

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CHAPTER IV

THE FEEDING OF ANIMALS

By W. H. JORDAN

FEEDING OF ANIMALS CANNOT BE GOVERNED BY MERE RULES and formulas. The subject of animal nutrition is broad and exceedingly complex. It involves a profound knowledge of certain phases of physics, chemistry and physiology, as well as a practical acquaintance with the characteristics of animals as sentient organisms. Moreover, it is a subject in the understanding of which slow progress has been made because of the great difficulties that are met in studying its problems. In the science of nutrition, with both plants and animals, many conclusions must be reached by inference rather than by direct observation. Life-processes are hidden and the deductions of the investigator must be drawn largely from a measurement of end results, such as the solid and liquid excretions, the heat radiated by the animal as an expression of the energy utilized under given conditions, or the amount and character of the milk or body substance produced under a particular system of feeding. The course that a certain compound travels after it is taken into the animal's digestive tract and the influence it exerts on life processes can generally be ascertained only by reasoning from well-known principles or on the basis of exterior phenomena.

Before the days of scientific investigation in this field, long-continued experience in feeding animals had resulted in many precepts relating to this art, some of which were undoubtedly a sound basis for practice. But this traditional code of knowledge consisted of unexplained rules. While we owe much to the observations of the practical man, and while science has devoted much time to explaining facts with which he was already familiar, out of such unsystematic and superficial observations as are generally made in the stable can grow only an empirical practice, which has in it few of the elements of progress and safety. In order to reason from facts and principles of general application, it is necessary to know the compounds of cattle foods and their properties, the composition, structure and life-processes of the animal body, and the relations the food compounds sustain to its growth, maintenance and physiological status. Briefly, then, what has so far been accomplished in building up a body of knowledge that not only may properly be called a science of nutrition, but may be made of real assistance to those producing meat and milk?

(1) We have acquired a somewhat extended knowledge of the compounds found in cattle foods and of the actual and relative composition of many feeds. This knowledge, when used in connection with related facts, permits a classification of any individual feeding-stuff as to the place it may be expected to fill in a ration. It permits the safe substitution of one feed for another when price or availability makes this desirable, without materially modifying the amount or character of the nutrition.

(2) Extensive determinations have been made of the digestibility, or availability, of feeding-stuffs, and of the influence on digestibility of various conditions, such as stage of growth of the plant, the amount of ingested food and the way foods are combined.

(3) Fruitful results have come from long-continued investigations as to the functions of food compounds in building and maintaining the animal body. Notwithstanding the great difficulties in this field of inquiry, certain facts are well established, such as the formation of muscular tissue exclusively from food proteids, the production of animal fats from carbohydrates, and the maintenance of the internal and external work of the animal organism, chiefly by oxidation of the non-nitrogenous food compounds.

(4) By the use of the respiration calorimeter, with which it is possible to measure the income and outgo of the animal body and the heat-production as well, it has been learned that the principle of the correlation and conservation of energy holds good in the maintenance and operation of the living mechanism. By the same means, the relative energy-value of the different food compounds has been ascertained

by physiological measurements, and the minimum quantities of the different nutrients required to maintain an animal of a given kind and weight have been determined. Among the most recent and most enlightening results with this apparatus has been the measurement of the net productive value of feeds of different classes. This value for a unit of digested dry substance has been found to differ greatly, according to the source of the nutritive material. More specifically stated, the net productive energy, that is, the energy balance, after deducting from the total food-energy that is lost in the excreta and unoxidized gases and that which is used in the work of digestion and assimilation, is greater for a unit of digestible dry matter from the more easily masticated and digested grains than it is with the coarse materials, as the hays, straws and other fodders. This well-grounded conclusion sets at naught estimates of the relative values of feeds that were previously held, and provides a new and more accurate standard of measurements in animal nutrition.

(5) Feeding experiments have demonstrated the usefulness of a great variety of new by-product feeds and their adaptability to various classes of animals. Rations unlike in amount and in their combinations of nutrients have been compared as to their effect on the quantity and quality of the product.

(6) It is fair to ask, What has come out of this great mass of data that may serve as a definite guide to practice? As far back as the days of Thaer, an attempt was made to use hay equivalents, that is, the relative values of cattle foods in terms of hay, as a basis for feeding. It is now easy to see how irrational this scheme was. The first ambitious effort at the formulation of a systematic method of feeding based on modern data from chemical and physiological research, fortified by a limited number of practical demonstrations, was the German feeding standards. These standards consisted of a recommendation of definite quantities of digestible nutrients to be fed in accordance with weight, age and purpose, whether for a growing, fattening, working, or milk-producing animal. They assumed a uniform value for a unit of digestible matter without reference to its source. Later, certain modifications have been introduced, allowing for the source of the nutrients and the rate of production of milch cows. Notwithstanding that these feeding formulas were derived from insufficient data and are imperfect, they have had a marked, and in general a beneficial, effect on feeding practices. They have induced a study of feeding-stuffs and of the equivalence of rations, and in general have promoted uniformity of feeding. An attendant evil has been their acceptance as rules rather than as suggestions. It seems to have been assumed that the profits from a ration would hinge on its physiological efficiency, and dairymen have often felt that they must purchase protein feeds at any price and under any conditions in order to comply with an orthodox creed. Such an application of feeding formulas is not rational, and practical men are coming to understand this. It now seems probable that the day of a blind adherence to fixed feeding formulas is past. Apart from the uncertainty caused by conflicting data as to what is the really necessary minimum proportion of protein in a ration, we have reached the broader conception that the production of milk or meat is a business, and the methods adopted should be regulated by market prices and other conditions. The situation is often such with a given farmer that a ration varying widely from the standard may be wise from a business point of view.

(7) The knowledge gained in the study of animal nutrition has exerted considerable influence on methods of farm management and commercial standards. Magnifying the nutritive importance of protein as many authorities have done, and as the feeding standards tend to do, has caused leguminous crops, such as alfalfa and the clovers, to take on an added importance in the scheme of crop-production, and has had the effect of causing many buyers to purchase feeds with almost exclusive reference to their protein content. The same point of view has found expression in legislation for controlling the sale of commercial feeding-stuffs, in obliging manufacturers to guarantee the percentages of protein and fat.

Nothing is more rational than to encourage the production of leguminous crops, for this practice certainly tends to minimize the over-dependence on the markets which, in these days, when so large a proportion of the commercial feeds are of inferior quality, is proving to be a serious financial handicap to cattle-owners, especially dairymen. But on the other hand, the prominence given to protein in standardizing feeds, both in terms of law and in commercial estimates, is irrational. There is no good reason why the protein content of a feed should be considered to the exclusion of such an important factor as the nature of the accompanying non-nitrogeneous compounds. These facts are mentioned as evidence that there should occur something of a readjustment of at least the popular point of view, as to values in feeding-stuffs. It does not appear that the aid the art of feeding animals will receive from science in the future will be in the nature of rules, but rather through the application of general principles to the special circumstances under which the feeding is practiced. This means, then, the placing of greater emphasis on the intelligence and judgment of the feeder.

PRINCIPLES OF STOCK-FEEDING

By *Henry Prentiss Armsby*

For the present purpose the discussion of stock-feeding may be considered under three general heads: (1) The principles of nutrition; (2) feeding-stuffs; (3) feeding. These captions are taken up in order in the following pages.

I. The Principles of Nutrition

The chemical basis of plants and animals.

The business of the stock-feeder is the conversion of vegetable into animal products. To do this intelligently, he must know, first of all, of what these products are composed. Fortunately, the almost innumerable substances contained in plants and animals may be grouped, for this purpose, under five heads, viz., water, ash, protein, carbohydrates and fats.

Protein is a general term for all those ingredients of the plant or animal which contain the element nitrogen. Protein is subdivided into (1) proteids and (2) non-proteids.

(1) The proteids are intimately associated with the life of the plant or animal, being the characteristic ingredients of the protoplasm through which all life manifests itself. In the animal they may be said to be the basis of the working machinery of the body. The organic part of the bones, the ligaments which bind the bones together, the muscles (lean meat) and tendons which move them, the skin, hair, hoofs and horns, the brain and nerves, the internal organs, are all composed, aside from the water which they contain, very largely of proteids, while the fat of the body, though often exceeding the proteids in amount, is essentially reserve material and may vary greatly without affecting the working of the body. In the plant the proteids are less obvious, but no less essential. In the young and growing parts they are present in abundance, and they are freely supplied to the seeds, some of which, as those of cotton and flax, contain very large amounts of them. In the plant as a whole, however, they are present in small proportion as compared with the carbohydrates.

(2) The non-proteids include a large number of substances which contain nitrogen but are not proteids. They are, in general, comparatively simple, crystalline bodies, soluble in water, many of them belonging to the group of "amides." In the animal, they are represented by the nitrogenous extractives of lean meat. Their exact nutritive value is still in doubt, but it is probably less than that of the proteids.

The carbohydrates comprise some very familiar substances, such as the sugars, dextrin, the gums, starch and cellulose, as well as many others known only to the chemist. They contain no nitrogen, and contain hydrogen and oxygen in the exact proportions to form water. They may be said to be essentially vegetable products, although one of them (glycogen) is peculiar to the animal. Cellulose, with more or less encrusting material, constitutes the framework of plants, while starch and the sugars are found abundantly in nearly all parts of them, and form an important ingredient of the food of herbivorous animals.

The fats are familiar bodies and need no special description. The true fats of the plant are very similar to those of the animal. Like the carbohydrates, the fats contain no nitrogen, but they contain relatively less hydrogen and oxygen and more carbon than the latter and are a more concentrated food.

The ash is essentially material derived from the soil through the roots of the plant. The various ingredients of the ash doubtless have important functions in nutrition, but the subject has been little studied and it is generally assumed that a ration composed of normal feeds will supply sufficient ash ingredients.

Water makes up, in round numbers, 40 to 60 per cent of the weight of the animal. In feeding-stuffs it may range from 10 or 12 per cent in very dry material to over 90 per cent in very succulent feeds, such as roots.

Composition of the animal body.

Of the substances mentioned in the foregoing section, water, ash, fat and proteids make up the great mass of the animal body. While carbohydrates are also contained in it, their amount is so small that for our present purpose it may be neglected.

Water.—All parts of the body contain a rather large proportion of water, which is as essentially an ingredient of the tissues as any other substance.

Water serves a physical purpose by imparting the proper degree of elasticity and flexibility to the various tissues. It is likewise the great solvent of the body. The food is taken up into the tissues dissolved in water, and water is the vehicle in which it is carried to all parts of the organism and in which the waste products are finally excreted from the body.

Ash.—The ash, or mineral matter, is most obvious in the bones of the animal, but it is also contained in smaller proportion in every part of the body, and its presence in proper kind and amount is essential to the vital activities of the cells.

Proteids. As already stated, the great bulk of what we may call the working machinery of the body is composed of proteids, accompanied by ash ingredients and a considerable amount of water. It is obvious then that a due supply of the proteids in the food is an exceedingly important matter.

Fat.—The fat of the body is its reserve material. It is formed when more food is given than the immediate needs of the animal require, and is stored up in certain special tissues, called adipose tissues, to be drawn on later if the food supply is insufficient.

The following table shows the average composition of bodies of cattle, sheep and swine in various stages of fatness. As appears from this table, the fat is the variable ingredient in the body, its amount depending on the feeding, while the relative amounts of water, ash and proteids vary much less.

PERCENTAGE COMPOSITION OF LIVE ANIMALS

	Ox				Sheep					Swine	
	Well-fed	Half fat	Fat	Fat calf	Lean	Well-fed	Half fat	Fat	Very fat	Well-fed	Fat
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Water	54.3	50.2	43.6	60.1	56.6	53.7	50.7	44.8	39.0	53.9	42.0
Ash	4.8	4.4	3.9	4.5	3.4	3.3	3.2	2.9	2.8	2.7	1.8
Fat	7.1	14.9	26.8	13.1	8.6	13.2	18.3	28.1	37.2	22.5	40.2
Protein	15.8	15.5	13.7	15.3	15.4	14.8	13.8	12.2	11.0	13.9	11.0
Contents of stomach and intestine	18.0	15.0	12.0	7.0	16.0	15.0	14.0	12.0	10.0	7.0	5.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

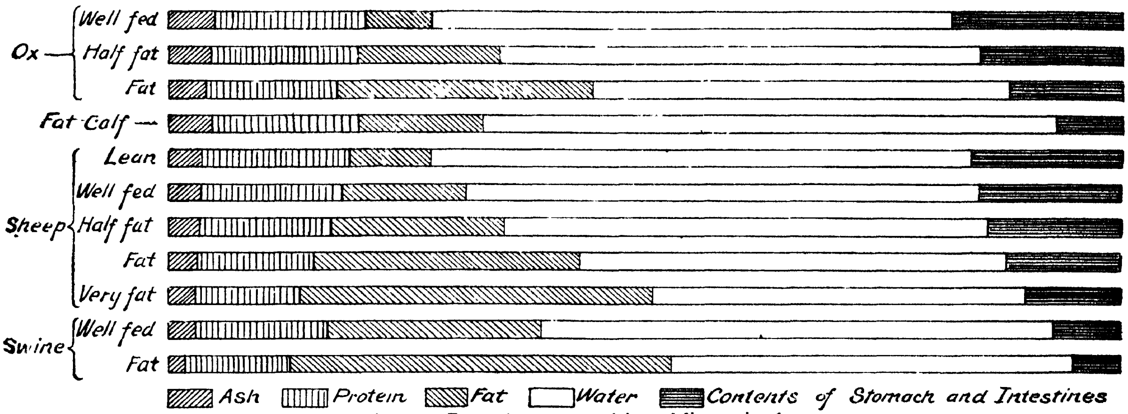


Fig. 58. Percentage composition of live animals.

The composition and digestibility of feeding-stuffs. The value of a feeding-stuff evidently depends, in large part at least, on the amounts of proteids, carbohydrates, fats and ash present in an available form. The total amounts present may be determined with more or less accuracy by chemical analysis. The results of such analyses are usually stated as in the following examples:

	Clover hay	Corn meal
Water	15.00	15.00
Ash	5.47	1.23
Proteids	10.13	8.67
Non-proteids	1.45	0.25
Crude fiber	28.71	1.86
Nitrogen-free extract	36.86	69.40
Crude fat	2.38	3.59
	100.00	100.00

The crude fat is the material extracted by dry ether. It contains the true fat of the feeding-stuff and also more or less other material, such as wax, the green coloring matter of the plant, and the like. Crude fiber is the residue left after treating the feeding-stuff successively with dilute acid, dilute potash, alcohol and ether. Its chief ingredient is cellulose, a substance (or substances) belonging to the group of carbohydrates. Clean cotton or linen fiber are familiar forms of cellulose. The crude fiber of young plants or parts of plants and of seeds is chiefly cellulose, but that of more mature plants contains considerable amounts of encrusting substances, making it woody and tough. The nitrogen-free extract includes all the more soluble carbohydrates, such as starch, dextrin, gums, sugars, and the like, and also, especially in the coarse fodders, a great variety of other substances, some of them little known. In brief, the carbohydrates of feeding-stuffs are divided into two classes: The less soluble, contained in the crude fiber, and the more soluble, contained in the nitrogen-free extract. The amount of crude fiber serves to some extent to indicate the bulk and coarseness of the material.

It is not the total amounts of these ingredients, however, but the amounts which the animal can digest out of them which is the important factor in determining the value of a feeding-stuff. By the various processes to which it is subjected in the alimentary canal, a part, and usually only a part, of each ingredient is so far modified as to render it capable of being taken up into the circulation and of contributing to the maintenance and growth of the body. The digested portions of the proteids and of the crude fat are regarded as consisting essentially of proteids and true fat respectively. The digested portions of the crude fiber and of the nitrogen-free extract have been shown to have the same chemical composition and energy value (see below)

as cellulose or starch, and they have accordingly been regarded as consisting of carbohydrates. It should be noted, however, that in herbivorous animals a not inconsiderable proportion of the carbohydrates undergoes fermentation in the paunch

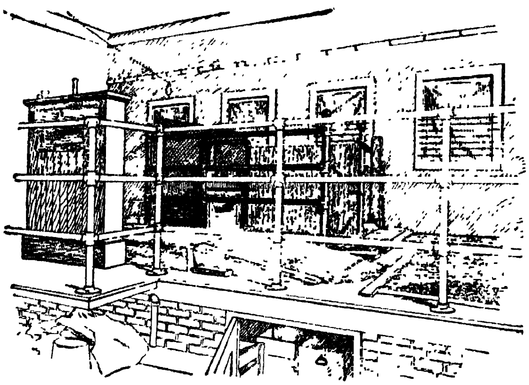


Fig. 59. Stall used in digestion experiments.

and cæcum, yielding carbon dioxid, marsh gas, and soluble products of inferior nutritive value, chiefly organic acids. The materials thus dissolved in the digestive tract are often spoken of as digestible nutrients. The undigested part of the feeding-stuffs is rejected in the dung, or solid excrement, which, in herbivorous animals, may be regarded as consisting essentially of the indigestible part of the food, mixed with small amounts of residues of the digestive juices, intestinal mucus, and other waste products of the activity of the digestive organs. If, then, we weigh and analyze the feed and the dung of an animal and compute the number of pounds of ash, proteids, crude fiber, and the like, contained in each, we shall find the amounts smaller in the dung than in the feed. The difference between the two amounts shows in each case how much of that particular substance has been dissolved out of the food and taken up into the body; that is, it shows how much of that ingredient was digestible. The results are commonly expressed as percentages of the total amounts fed. Thus in an actual experiment, the feed contained 5.74 pounds of crude fiber and the dung 2.86 pounds; evidently, therefore, 2.88 pounds were digested. Accordingly, dividing 2.88 by 5.74 we find that 50.17 per cent of the crude fiber was digestible. The latter figure is called the percentage digestibility, or sometimes the digestion coefficient, of the crude fiber, and by the same method similar coefficients may be obtained for all the other ingredients of the feed.

Conditions affecting digestion.

The digestibility of the several ingredients of feeding-stuffs is found to vary considerably under different conditions. Some of these conditions affect digestibility by modifying the character of the material fed, and will be considered later. Others modify, or may be supposed to modify, the character of the digestive processes, and may be taken up here.

The quantity of feed consumed seems, under some conditions, to affect its digestion. Differences in the amounts of coarse fodder consumed have usually had no effect on the percentage digestibility. On the other hand, increasing the amount of a mixed ration fed has resulted in some decrease in the percentage digestibility, although the difference has generally been small. As the bulk of the ration is increased, it must naturally pass through the digestive tract more rapidly and thus be exposed for a shorter time to the action of the digestive fluids and of the resorbent organs. Moreover, with large grain rations, it is possible that the limit of the activity of the resorbent organs may be reached, and that material may be dissolved more rapidly than it can be taken up into the circulation.

The proportions of the nutrients in a ration may also affect its digestion. In particular, it has been found that an excess of easily digestible carbohydrates reduces the digestibility of both the protein, the crude fiber and the nitrogen-free extract. This is most plainly shown when a pure carbohydrate, as starch or sugar, is added to a ration, but the same effect may be produced by any feeding-stuff rich in carbohydrates, as roots, potatoes or corn, when used freely. On the other hand, the addition of protein to a ration over-rich in carbohydrates has the contrary effect of increasing its digestibility. It is stated that to insure full digestibility in case of cattle, the ration should contain not less than one part of digestible crude protein for each eight parts of digestible carbohydrates and fat, while for swine the ratio may be as large as one to twelve. The effect on the digestibility of the protein is more apparent than real. It seems to arise chiefly from the fact that

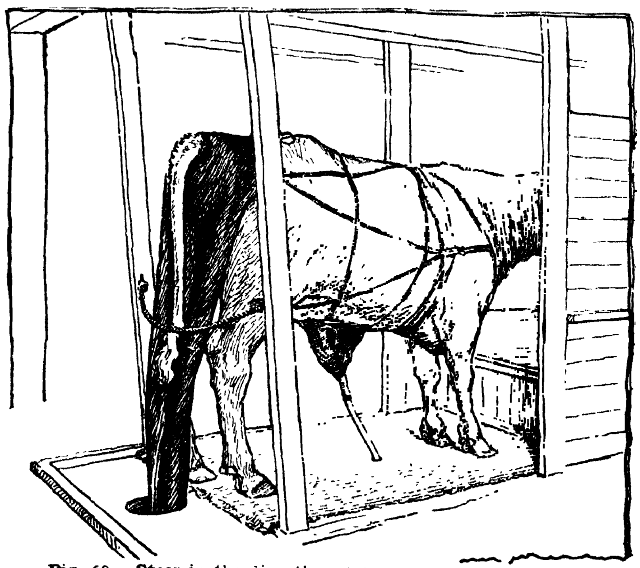


Fig. 60. Steer in the digestion stall with harness in place

in the digestion of food of any kind a certain amount of nitrogenous waste products is produced by the digestive organs and excreted in the feces, where, by the ordinary methods of digestion experiments, it is regarded as undigested protein of the food. When such allowance as is possible is made for these waste products, the real digestibility of the protein is found to be little affected. On the other hand, the decrease in the digestibility of the nitrogen-free extract and crude fiber is not susceptible of any such explanation, but is a real effect. Its cause has not been fully elucidated, but seems to be connected with modifications in the fermentations taking place in the digestive organs, due to the difference in the character of the food supply to the bacteria and other organisms inhabiting the alimentary canal. This is indicated by the fact, among others, that addition of substances like asparagin or ammonium acetate to the ration has been found as effective in overcoming this depression in digestibility as has addition of true proteids.

Species of animal.—A number of conditions pertaining to the animal are also to be considered in regard to their effect on digestion. Of these, the most important is the species. The different species of ruminants (specifically, cattle and sheep) show no material differences in their digestive power for most feeding-stuffs, and especially for concentrated feeds. In case of the more difficultly digestible coarse fodders, such as straw or corn stover, however, cattle show a distinctly higher digestive power, which has been regarded as due to more extensive fermentations in the more watery contents of the lower intestines. The digestive organs of the horse have a less capacity than those of ruminants, and the mastication of the food is less complete. Accordingly, as might be expected, the horse digests coarse fodders less completely, the difference naturally being greater with the less easily digestible ones. Straw is digested only to about half the extent by the horse that it is by sheep. For hay and similar materials the digestibility by the horse is 20 to 25 per cent lower than that by sheep. With clover or alfalfa hay the difference falls to about 10 per cent, while concentrates are digested practically to the same extent by both species. The crude protein of all these materials is about equally well digested by both animals, the differences falling chiefly on the carbohydrates. As in the comparison of sheep and cattle, this probably means a less extensive fermentation in the digestive tract, and may not necessarily imply any lower nutritive value for the feeding-stuff in one case than in the other. The crude fat is apparently less completely digested by the horse than by ruminants, but this seems to be due to the presence in the dung of the horse of relatively larger amounts of ether-soluble waste products, and thus to be apparent rather than real.

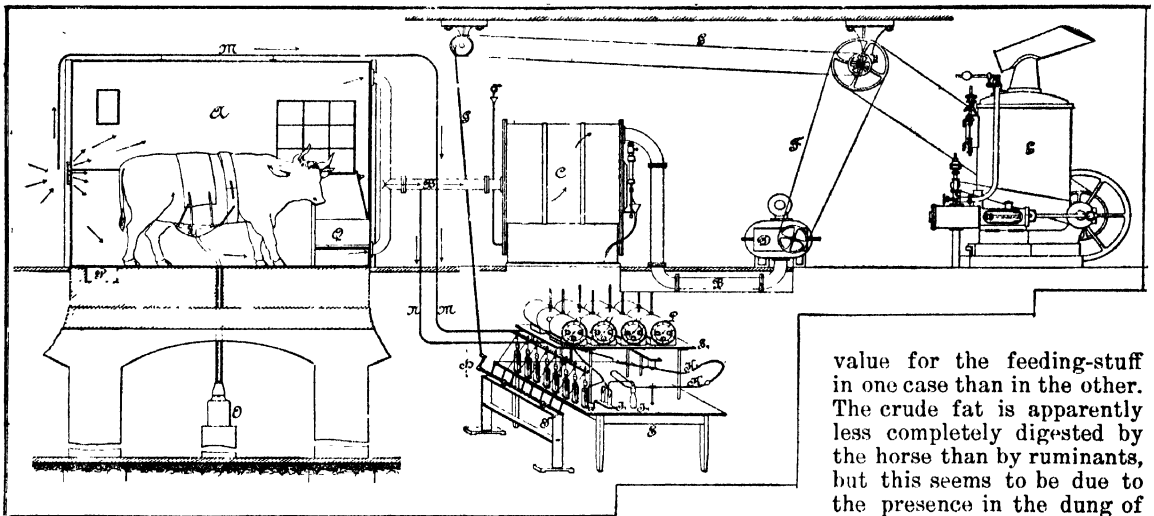


Fig. 61. The Mœckern respiration apparatus. (Adapted from Die Landw. Versuchs-Stationen, Vol. xliv, Plate I.)

Breed. Age. Work.— No significant differences have as yet been observed in the digestive powers of different breeds of the same species. Small differences, seldom exceeding 2 to 4 per cent, have been observed between individual animals, although they have been by no means constant and may have arisen in some cases from defective experimental methods. With normal animals they are of little practical significance. Neither has the digestive capacity been found to vary with age, within the limits of full development of the digestive apparatus. The undoubted differences in the productive capacity of different animals, or of the same animal at different times, are due to other causes than differences in digestibility.

Work, even when very considerable in amount, has not been found to affect the digestion of the ration provided it is performed at a moderate rate (ordinary walk). Work at a more rapid pace (trot) has been found by some experimenters to diminish the digestibility to some extent, while others have found indications of a stimulating effect of work on the digestive processes.

Considerable stress has been laid by some writers on the order in which coarse fodders, concentrated feed and water are given, particularly in case of the horse; but such exact investigations as have been made have failed to confirm these opinions. Neither does it appear that the frequency of feeding, within reasonable limits, materially affects the digestion.

Fate of the digestible nutrients.

An animal—a working horse, for example—may digest large amounts of material from its food and yet neither gain weight nor excrete any large part of the digested matter, aside from water, in a visible form. The digested nutrients are oxidized, or burned, in the body, and the products of their combustion leave the body largely in the gaseous form. This is entirely true of the carbohydrates, fats and other non-nitrogenous materials. The products of their combustion are carbon dioxid, excreted through the lungs and to a much less degree through the skin, and water, excreted through lungs, skin, and in liquid form in the urine. The same thing is largely true of the proteids and non-proteids, but their nitrogen, together with a part of their carbon, hydrogen and and oxygen, is converted into a substance called urea which is excreted in solution in the urine. Small portions of the nitrogen are also found in the urine in the form of more complex compounds, but all the nitrogen of the protein is ultimately found in the urine in one form or another. This process of breaking down and oxidation of the digested nutrients is given the technical name of metabolism.

Functions of nutrients.

As was pointed out in a previous paragraph, the body of the animal may be regarded as made up substantially of water, ash, fat and proteids. When an animal is deprived of food, it subsists on its own tissues, burning up the proteids and especially the fats contained in its body. The object of the food is to make good the losses thus occasioned.

The protein of the food is the only source from which the animal can make good the loss of proteids from its tissues, or from which it can secure material for new growth, since it has no power of manufacturing proteids from non-nitrogenous ingredients of the food. Accordingly, the growing animal or one producing milk, which contains much proteids, requires a liberal supply of these ingredients, while a relatively smaller amount will suffice for mature, fattening or work animals. The proteids of the food or of the tissues, when oxidized, finally yield, as already stated, carbon dioxid, water, urea and some other nitrogenous products.

The fats and carbohydrates of the food serve to make good the losses of fat in the body or to produce new fat, and also to supply the necessary energy and heat for the vital activities of the organism. This is likewise true of the proteids, if present in excess of the needs of the animal, and also of the tissue proteids broken down. at least so far as supplying energy is concerned. Whether the proteids can serve as a source of fat to the body is still a moot point, although the probabilities are in favor of it.

The ash of the food serves to make good the constant loss of mineral matter which is taking place from the body and to supply material for new growth. A due supply of it is particularly important, then, to the growing or the milk-producing animal. The laws regulating the use of mineral matter in the body, however, have as yet been rather imperfectly investigated.

The work of the body.

While it is neither humane nor economical to treat domestic animals simply as machines, nevertheless, from some points of view, the animal body is a very wonderful machine. Its mechanical construction, which forms the subject matter of the science of anatomy, is a fascinating study, but what is of especial interest in this connection is another analogy with a machine.

All are familiar with the operation of the steam engine and know, at least in a general way, that the heat energy set free by the burning of the fuel under the boiler is made, through the medium of the steam, to produce power in the engine. In the gas, gasoline or alcohol engine the matter is still simpler, the fuel being burned and performing its work in the cylinder of the engine.

Something similar takes place in the animal body. It consumes food out of which it digests certain substances. These substances are then, in the processes of metabolism which we have just considered, broken down and oxidized (i. e., in a sense, burned) and yield much the same products that they would if burned under the boiler of a steam engine. In this breaking down and oxidation — i. e., in their metabolism — the protein, carbohydrates and fats develop the power which actuates the body machinery and enables it to do work. The process, however, is very different from that in the steam engine. In the animal body we have combustion at a low temperature, ranging from 99° to 104° Fahr. In the steam engine the combustion produces heat and the heat produces motion; in the body, the combustion seems to produce motion directly, although heat is also produced at the same time. The body is not a heat engine.

The animal body then resembles the steam or gasoline engine in being a converter of energy. It changes the stored-up energy of its food, derived ultimately from the sun's rays, into the form of work. This is very clear in the case of the working animal, but it is equally true, although not at first thought so obvious, in the case of the animal kept for the production of meat or milk. The prime object of the food, in every case, is to keep the bodily machinery running, while the storage of protein or fat in the tissues or the milk, is, in a sense, incidental. The fattening animal stores up fat to be used as fuel later in case of a shortage of food; the growing animal enlarges the machine that it may be able to perform more work; the milking animal contributes indirectly a part of its food to the support of its young—i. e., to the run-

ning of another machine. In all cases, the chief physiological end is the conversion of the energy of the food into work of one sort or another.

Regarding the animal body from this point of view,—that is, as a machine for the conversion of potential energy into work,—the question at once arises as to its requirements in the way of food to keep the machine running, and as to the part played in its operation by the several ingredients of the food.

The steam engine requires occasional repairs as one or another part becomes worn. The essential parts of that living machine called the body are, as has been seen, composed chiefly of proteids. Accordingly, we should expect that a supply of proteids would be necessary to keep this machine in repair, just as steel, brass, and the like, would be needed for repairs in the engine; and such, in fact, is the case. The body has this advantage over the engine, however, that it is self-repairing, provided the necessary materials are supplied to it.

In addition to repair material, the animal, like the engine, requires a supply of fuel, and if this is not furnished in the food it consumes the materials of its own body for this purpose. This is true even when the animal is doing no visible work. Its heart, respiratory organs and other parts of the body are still doing work. The case is like that of an engine run with no load, which still requires a certain amount of fuel to keep it moving. In both cases all the energy of the fuel burned finally appears as heat, which in the animal serves to maintain the normal temperature of the body. All three of the principal ingredients of the digested food, proteids, carbohydrates and fats, may serve as fuel, since they are all more or less completely burned in the body, but they are not equally valuable. Fat is the most concentrated form of fuel, one pound of it producing about about two and one-fourth times as much heat in the body as the same weight of proteids or carbohydrates. Most feeding-stuffs are rather poor in fat, however, and this substance does not usually play any large part in supplying energy to the body in herbivorous animals. The carbohydrates are the chief source of energy to domestic animals, being abundantly supplied, in easily digestible forms, in ordinary feeding-stuffs. The proteids, so far as they are not stored up in the products, such as meat or milk, and likewise the body proteids metabolized, also serve as fuel to the body, being about equally valuable with the carbohydrates for this purpose. Some burning of proteids in this way is unavoidable, but an unnecessary use of proteids as fuel, such as would result from the presence of an undue proportion of them in the food, is to be avoided because they are usually the most expensive part of a ration to produce or buy.

II. Feeding-Stuffs

Relative values of feeding-stuffs.

An exceedingly important question for the stock-feeder is what relative amounts of animal product of any given kind he can produce from his various raw materials — the feeding-stuffs. In the light of the foregoing discussion, it is plain that this must depend on the quantities of proteids which they can furnish for repair and constructive purposes, and on the supply of energy afforded by their digestible matter.

Digestible nutrients.—The method of comparing feeding-stuffs now in vogue is based on their chemical composition and the digestibility of the several ingredients as determined by experiments on animals. For example, actual trials with the samples of clover hay and corn meal whose composition has already been given showed that cattle digested the following percentages of the several ingredients:

Percentage Digestibility

	Clover hay	Corn meal
Proteids	53.19	66.43
Non-proteids	(100.00)	(100.00)
Crude fiber	50.27	32.40
Nitrogen-free extract	68.94	97.75
Crude fat	65.02	95.74

To compute the percentages of digestible nutrients in each material, we proceed as follows, water and ash being omitted from the computation:

	Clover hay	Corn meal
Proteids	10.13 x 0.5319 = 5.39 per cent	8.67 x 0.6643 = 5.76 per cent
Non-proteids	1.45 x 1.0 = 1.45 per cent	0.25 x 1.0 = 0.25 per cent
Crude fiber	28.71 x 0.5027 = 14.43 per cent	1.86 x 0.3240 = 0.60 per cent
Nitrogen-free extract	36.86 x 0.6894 = 25.41 per cent	69.40 x 0.9775 = 67.84 per cent
Crude fat	2.38 x 0.6502 = 1.55 per cent	3.59 x 0.9574 = 3.44 per cent

Since the digestible crude fiber and the digestible nitrogen-free extract have been shown to have the same chemical composition, they are commonly added together and called digestible carbohydrates, while the digestible crude fat is regarded as consisting of fat. The digestible ash ingredients have not usually been taken account of, it being assumed that the average ration which is sufficient in other respects will contain all the ash required. Omitting these, the digestible ingredients are:

	Clover hay	Corn meal
	Per cent	Per cent
Digestible proteids	5.39	5.76
Digestible non-proteids	1.45	0.25
Digestible carbohydrates	39.84	68.44
Digestible fat	1.55	3.44

This comparison may be still further simplified. A pound of fat produces when burned about two and one-fourth times as much heat as the same weight of carbohydrates. The non-proteids have somewhere near the same heat value as the carbohydrates, and since it is doubtful whether they help build up proteid tissue we may class them with the carbohydrates. *The digestible nutrients can thus be grouped into two classes, viz., the proteids, which serve primarily to keep the working tissues in repair or to build up new tissues, and the other materials, which serve as the chief sources of energy to run the animal machine.*

	Clover hay	Corn meal
	Per cent	Per cent
Digestible proteids	5.39	5.76
Digestible carbohydrate equivalent	44.78	76.43
Total digestible nutrients	50.17	82.19

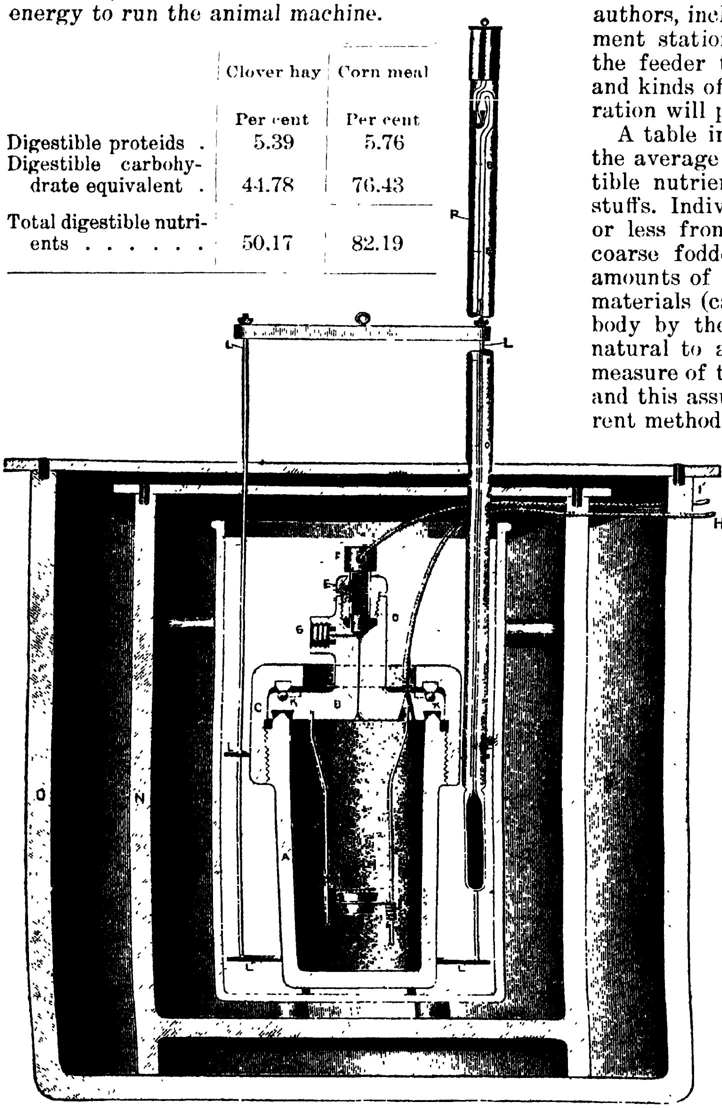


Fig. 62. Section of Bomb calorimeter. Used to determine total energy of feeding-stuffs. (Adapted from Bulletin No. 21, Office of Experiment Stations.)

As sources of total nutrients, therefore, in round numbers, fifty pounds of the corn meal would be equivalent to eighty-two pounds of the clover hay, while as sources of digestible proteids there is a slight superiority on the part of the corn meal, due to its greater digestibility.

A vast amount of labor has been expended during the past half century in determining the composition and digestibility of feeding-stuffs substantially in the manner outlined in this and the preceding sections. *At the present time, we have in general a fair knowledge of the amounts and proportions of the digestible matters supplied by most of the ordinary feeding-stuffs, and of the variations due to soil, season, maturity and other factors.* Extensive tables of averages have been published by various authors, including many of the agricultural experiment stations, and it is an easy matter today for the feeder to know approximately what amounts and kinds of digestible nutrients any given food or ration will probably supply.

A table in a following section (page 67) shows the average amounts of total dry matter and digestible nutrients in a number of common feeding-stuffs. Individual samples may, of course, vary more or less from the average, especially in case of the coarse fodders. Such tables inform us as to the amounts of repair materials (proteids) and of fuel materials (carbohydrates and fats) supplied to the body by the various feeding-stuffs. It has been natural to assume, therefore, that they afford a measure of the relative values of the feeding-stuffs, and this assumption has been the basis of the current methods of computing rations. Analyses and digestion experiments as ordinarily conducted, however, afford no direct information whatever as to the effect of the digested matters in supporting the animal or producing gain. It is not even necessary to weigh the animal in a digestion experiment. The conclusion as to the nutritive value of the feeding-stuff is simply an inference, based on general physiological facts, and its correctness is more than questionable in the light of recent investigation. In other words, the comparison is of what the material contains and not of what it accomplishes.

This is true of the feed as a source of proteids and especially as a source of energy. So far as the proteids are concerned, however, it is practically the only basis of comparison now available. Few studies of the relative nutritive values of different proteids have been made, and few of these relate to the proteids of ordinary farm feeding-stuffs. For the present, therefore, we must continue to treat the digestible proteids of different feeding-stuffs as of equal value as repair material, pending further investigation. On the other hand, recent investigations on the food as a source of energy, in which the amounts of energy concerned have been determined directly, have thrown much new light on this branch of the subject.

Energy values.—(1) Total energy.—The total store of energy in the food of an animal may be measured, like that in the fuel of an engine, by the amount of heat which it produces when completely burned. The unit commonly used for measuring heat is the Calorie, which is the amount of heat required to raise the temperature of one kilogram of water through 1° C. (or 3.962 pounds through 1° Fahr.). Thus, one gram (15.45 grains) of the clover hay and of the corn meal already used as illustrations gave off when completely burned the following amounts of heat:

Clover hay	3.788 Calories
Corn meal	3.766 Calories

Expressed per one hundred pounds, for greater convenience, this would be

Total Energy Per One Hundred Pounds

Clover hay	172,100 Calories
Corn meal	170,900 Calories

(2) Fuel values.—Not all of this energy, however, is available to the animal which consumes the feed, because the later is not completely burned in the body. More or less of it fails to be digested, and is rejected in the dung, carrying part of the energy with it. Another part of the energy is carried off unused in the urea and other organic substances excreted in the urine. Finally, the marsh gas produced in the digestive tract by the fermentation of the carbohydrates also carries off considerable unused energy. Thus, it was found that, for each hundred pounds of the clover hay or the corn meal fed to a steer, the following amounts of energy were contained in the waste products:

Per Hundred Pounds

	Clover hay		Corn meal	
Total energy		172,100 Cals.		170,900 Cals.
Losses in dung	73,600 Cals.		15,700 Cals.	
Losses in urine	11,500 Cals.		6,500 Cals.	
Losses in marsh gas	12,300 Cals.		15,900 Cals.	
Total loss		97,400 Cals.		38,100 Cals.
Remainder		74,700 Cals.		132,800 Cals.

The remainder obtained by subtracting the losses from the total energy shows how much of the latter can be liberated in the body, and the example serves to illustrate the fact that this remainder is larger in the case of concentrated feeding-stuffs than in that of coarse feeds, chiefly because of the large proportion of indigestible substance in the latter. This remainder is often called the "fuel value" of the material, because it shows how much heat it can produce in the body in case none of it is utilized to produce gain. But while it measures the value of the food as a heat producer, this is far from being the only, or even the most important function of the food. In fact, the production of heat is in most cases rather incidental to other processes, and hence the fuel values of feeding-stuffs do not measure their nutritive values. Like the amount of digestible nutrients, they show what the various feeding-stuffs can supply to the body but not what use the body can make of it. To determine the latter it is necessary to measure the effect of the food on the body.

Not very many determinations of the fuel values of feeding-stuffs have yet been made. In many cases, however, they have been computed from the amounts of digestible nutrients by the use of the factors proposed by Rubner and by Atwater for human dietaries, viz.:

For 1 pound digestible proteids For 1 pound digestible carbohydrates	} 1860 Cals.
For 1 pound digestible fats	4220 Cals.

It has been shown, however, that these computed fuel values are considerably too high for ruminants and probably somewhat so for the horse.

(3) Maintenance values.—When the animal is deprived of food, or given an insufficient supply, it consumes more or less of the proteids and especially the fat of its own body to supply the energy required for its functions. If food be given to the animal, it will virtually use the energy of the food, so far as it is available, in place of oxidizing its own tissues, and the extent to which the loss of proteids and fat by the body is diminished is a measure of the real nutritive effect of the food. For example, a steer on a certain ration was shown to be losing from his body daily 41.4 grams[1] of proteids and 254.4 grams[1] of fat. The energy value of this loss is 2,578 Cals., that is, the steer was getting this part of the energy required to run his bodily machinery by burning the body itself. Then 1.34 kilograms[2] of timothy hay were added to the ration. On this new ration, the steer gained daily 0.6 gram of proteids and lost 76.0 grams of fat, equivalent to 758 Cals. The addition of 1.34 kilograms of timothy hay, then, enabled the steer to burn up less of his own body materials to the extent of 2,578 Cals.—758 Cals. = 1,820 Cals. The latter number, therefore, expresses the maintenance value of the 1.34 kilograms of this particular timothy hay in this experiment, equal to 1,359 Cals. per kilogram, or 617 Cals. per pound. It should be observed that this value is of an entirely different character from those secured by means of digestion experiments or from determinations of fuel values. It shows what one pound or one kilogram of the hay actually effected in the way of maintaining the steer, while the former results showed simply what amounts of digestible nutrients or of energy were supplied to the animal in a unit weight of the hay.

[1] 1 gram equals about 1-28 oz.

[2] 2.95 pounds, computed to 15 per cent water.

A second important point is that the maintenance values of feeding-stuffs as determined in this way are less than their fuel values, as illustrated in the following table:

VALUE PER 100 POUNDS FOR CATTLE

	Fuel value	Maintenance value	Per cent of fuel value available
Timothy hay	777 Cals.	489 Cals.*	62.92
Clover hay	802 Cals.	585 Cals.	72.90
Corn meal	1,308 Cals.	1,016 Cals.	77.76

* Average of two experiments

It thus appears that a part of the fuel values of feeding-stuffs, ranging in these instances from 22 to 37 per cent, either is not available as a source of energy to the animal machine or is put to some other use than maintenance. Both are doubtless true. The chemical changes which the food undergoes in digestion, and particularly the extensive fermentations taking place in the digestive tract, produce a considerable amount of heat which, while it may help to keep the body warm, is of no use to it as a source of energy. Furthermore, the chewing and digestion of the food involve a considerable amount of work in addition to what the body was doing before, and part of the energy of the food is expended in this way. It is only what is left after these two losses have been met that is available for maintenance, i. e., for running the bodily machinery in general. This has been called the "net available energy." The figures given above are the only results on the maintenance values of feeding-stuffs for cattle which have yet been reported. They serve to indicate, however, that the percentage of the fuel value available is greater in the concentrated feeds than in the coarse fodders, presumably because of the relatively smaller expenditure in digestion. For the horse, the following results have been computed by a method which involves a number of assumptions, the validity of some of which has been seriously questioned. The negative value for straw shows that, as thus computed, the energy which must be expended in its digestion exceeds its fuel value.

AVAILABLE ENERGY PER POUND FOR THE HORSE

Average meadow hay	327 Cals.
Alfalfa hay	421 Cals.
Red clover hay	303 Cals.
Straw of winter grain	—209 Cals.
Oats	882 Cals.
Corn	1,263 Cals.
Beans	1,094 Cals.
Peas	1,052 Cals.
Linseed cake	1,016 Cals.
Potatoes	357 Cals.
Carrots	166 Cals.

(4) Production values.—If the food of an animal supplies more net available energy than is needed for maintenance, common experience shows that a production of some sort results. The animal grows or fattens, or it gives milk or does work. Such investigations as have yet been made, however, seem to show that we do not get back in the form of work or meat or milk all the surplus of net available energy which we supply to the animal. It is like the case of a man whose wages are just sufficient to pay his expenses. When his pay is increased he puts part of the increase in the bank, but he also spends more. This is most clearly seen in the case of the working animal. If a horse receives a ration whose maintenance value — i. e. its net available energy — is, say 3,000 Cals. in excess of that needed to maintain the horse when doing no work, it has been found that he will be able to do continuously only about 1,000 Cals. of work per day. In other words, the horse can utilize about one-third of the maintenance value of his excess food—that is, feed in excess of that required for maintenance—in the form of work. Substantially the same thing appears to be true in fattening. Thus, the daily ration of a steer, consisting of a light feed of clover hay and of corn meal, was found to contain 13,616 Cals. of net available energy (maintenance value), while the amount actually required to maintain this animal was 8,467 Cals., so that a surplus of 5,149 Cals. was supplied in the corn meal. As was to be expected, the steer fattened. The amount of energy stored up in his gain, however, was not the entire 5,149 Cals., but only 3,525 Cals., or 68.5 per cent of the surplus. That is, while the surplus food supplied had the capacity to prevent loss of tissue to the extent of 5,149 Cals. it could produce an actual gain of only 3,525 Cals. In other words, the maintenance value of the corn meal was greater than its production value. But very few actual tests of this sort have been made, and it is not yet possible to state with certainty whether this is generally the case. It seems to be what might be reasonably expected, however. To convert the food of an animal into the complex compounds of actual flesh and fat requires a greater chemical change than to convert it into the simpler materials suitable to be metabolized. To produce these more complex substances, a greater expenditure of energy is necessary, and consequently less is left to be stored up.

Very extensive and careful determinations of the production values of feeding-stuffs for fattening cattle have been made within the last ten or twelve years by Kellner at the Möckern Experiment Station in Germany. The following table contains his production values calculated per 100 pounds for some common feeds. The table shows also the digestible nutrients computed in the ordinary way as well as the total crude fiber, and the amount of total dry matter. The table shows for example, that 100 pounds of average timothy hay will supply to cattle a little over two pounds of digestible proteids; while if fed in excess of maintenance it may be expected to produce a gain by the cattle equivalent to 33,562 Cals. In comparison with the hay, 100 pounds of corn would supply 6.79 pounds of digestible proteids, and when added to a

maintenance ration would cause a gain equivalent to 88,847 Cals. Corn meal is worth, according to these figures, 2.65 times as much for fattening as an equal amount of timothy hay.

values. For fattening sheep, it seems likely that Kellner's figures for cattle can be safely used. Recent investigations indicate that they also show the relative values for milk production, but the

PRODUCTION VALUES PER ONE HUNDRED POUNDS.—Computed according to Kellner.

Feeding-stuff	Total dry matter	Total crude fiber	Digestible			Production value
			Proteids	Carbo-hydrates	Fat	
	Pounds	Pounds	Pounds	Pounds	Pounds	Calories
Green fodder and silage:						
Alfalfa	28.20	7.40	2.50	11.20	0.41	10,806
Clover, red	29.20	8.10	2.21	14.82	0.69	14,528
Corn fodder	20.70	5.00	0.41	12.08	0.37	11,024
Corn silage	25.60	5.80	1.21	14.56	0.88	14,260
Hungarian-grass	28.90	9.20	1.33	15.63	0.36	13,149
Rye-grass	23.40	11.60	1.44	14.11	0.44	10,316
Timothy	38.40	11.80	1.04	21.22	0.64	17,809
Hays and dry coarse fodders:						
Alfalfa hay	91.60	25.00	6.93	37.33	1.38	34,413
Clover hay, red	84.70	24.80	5.41	38.15	1.81	34,748
Corn fodder, field-cured	57.8	14.3	2.13	32.34	1.15	30,538
Corn stover	59.5	19.7	1.80	33.16	0.57	26,536
Cowpea hay	89.3	20.1	8.57	38.40	1.51	42,769
Hungarian hay	92.30	27.70	3.00	51.67	1.34	44,031
Oat-grass hay	84.00	27.20	2.59	33.35	1.67	36,975
Soybean hay	88.70	22.30	7.68	38.72	1.54	38,656
Timothy hay	86.80	29.60	2.05	43.72	1.43	33,562
Straws:						
Oat	90.8	37.0	1.09	38.64	0.76	21,213
Rye	92.9	38.9	0.63	40.58	0.38	20,876
Wheat	90.4	38.1	0.37	36.30	0.40	16,562
Roots, etc.:						
Carrots	11.40	1.30	0.37	7.83	0.22	7,829
Mangels	9.10	0.80	0.14	5.65	0.11	4,621
Potatoes	21.10	0.60	0.45	16.43	. .	18,054
Turnips	9.50	1.20	0.22	6.46	0.11	5,746
Grains:						
Barley	89.1	2.7	8.37	64.83	1.60	80,758
Corn	89.1	2.1	6.79	66.12	4.97	88,847
Corn-and-cob meal	84.9	6.6	4.53	60.06	2.94	72,051
Oats	89.0	9.5	8.36	48.34	4.18	66,279
Rye	88.4	1.7	8.12	69.73	1.36	81,721
Wheat	89.5	1.8	8.90	69.21	1.68	82,636
By-products:						
Brewers' grains, wet	24.3	3.8	3.81	9.37	1.38	14,827
Cottonseed meal	91.8	5.6	35.15	16.52	12.58	84,206
Gluten feed, dry	91.9	6.4	19.95	54.22	5.35	79,422
Gluten meal (Buffalo)	91.8	6.1	21.56	43.02	11.87	85,464
Linseed meal—						
Old process	90.8	8.9	27.54	32.81	7.06	78,929
New process	90.1	8.8	29.26	38.72	2.90	74,677
Malt-sprouts	89.8	10.7	12.36	43.50	1.16	46,337
Rye bran	88.2	3.3	11.35	52.40	1.79	56,659
Wheat bran	88.5	9.0	10.21	41.23	2.87	48,233

A large amount of investigation has also been expended in determining the production values of feeds for the horse. These, however, are more conveniently considered in studying the feeding of that animal, and for the present we may content ourselves with the general statement already made that about one-third of the maintenance value is recovered in the form of work. For other species of animals, and for other productive purposes we have as yet no actual determinations of production investigations are far from being sufficient to establish this. For swine we have almost no data, but the production values for this animal are probably higher than those for ruminants.

The figures of the foregoing tables are averages of more or less numerous determinations of the maintenance or production values of feeding-stuffs. It is a familiar fact, however, that feeding-stuffs of the same name, especially coarse fodders, may have quite unequal values. The value of any par-

ticular sample will depend, first, on the total amount of proteids and energy which it contains, and second and more important on the proportions of these which escape utilization. Of the sources of loss, the largest is usually that represented by the undigested matter of the feces. For this reason, and also because this aspect of the matter has been the one most studied, particular attention will be devoted in the succeeding sections to a consideration of the more important conditions affecting composition and digestibility, particularly of coarse fodders.

The preservation and preparation of feeding-stuffs.

In most regions in which stock-feeding is practiced extensively, feeding crops have to be preserved in one way or another for use during part of the year. Whatever the method adopted for this purpose, there is usually more or less loss of material, and a greater or less effect on the digestibility. In general, two methods are available, drying or some form of ensiling.

Drying. — Numerous experiments have shown that the simple removal of water by drying does not materially affect the digestibility of forage. The actual preservation of forage by this method, however, involves much more than simple drying. First, the necessary handling of the material causes mechanical losses of the leaves and other tender parts, which tend to become dry and brittle before the stems are sufficiently cured. Second, there is more or less loss of material through the oxidations and fermentations which practically always make a part of the curing process. Finally, when exposed to rain there is more or less loss of soluble material by leaching. In all these cases, it is the more valuable and easily digestible parts of the material which are more readily lost, and naturally, therefore, the cured material is inferior to the green crop, both in composition and digestibility. For example, the loss of dry matter in curing alfalfa hay was found to be in one instance 7.13 per cent, and the composition and digestibility of the hay as compared with that of the same alfalfa, dried without loss, were :

	Composition of dry matter		Percentage digestibility	
	Dried without loss	Hay	Dried without loss	Hay
Crude protein	17.00	14.94	71	67
Crude fiber	31.81	33.90	48	45
Nitrogen-free extract and fat	43.80	44.22	66	62
Ash	7.39	6.94	29	23
Total dry matter	100.00	100.00	59	54

The extent of the losses will depend, of course, on the kind of material, the method of handling, degree of exposure, and other considerations. The legumes, with rather coarse stalks and delicate leaves, are usually subject to relatively larger mechanical losses than the grasses. Corn cured in the field may suffer largely from leaching and to some degree from fermentation, as well as from mechanical losses in handling when hauled in. In general, it is desirable to limit the drying of any crop to the minimum compatible with proper preservation.

Ensiling.—In the process of ensiling in its various forms, the mechanical losses are largely reduced, since the material is handled in the green state. On the other hand, the losses by fermentation are relatively magnified and may easily become very considerable. While losses as low as 2 per cent of the dry matter have been reported for corn, it is doubtful whether in ordinary practice they will be much less than 15 per cent, while losses of 40 per cent have been observed under extreme conditions. Since this loss falls on the more soluble and digestible ingredients of the feeding-stuff, the digestibility of the residue is naturally depressed. For example, the percentage digestibility of the organic matter of alfalfa and of esparsette in the green state and cured in different ways was as shown in the following table. The silage in this experiment had undergone extensive fermentation.

	Alfalfa	Esparsette
Green	57.8	67.4
Dried without loss	57.2	66.7
As hay	55.4	62.1
Partially dried and cured in the cock	54.5	. .
Fermented in the cock	. .	59.3
As silage	. .	44.9

The relative effect of field-curing and of ensiling on the loss of substance and consequently on the digestibility obviously will vary within wide limits, and one method or the other may give the better result according to the skill with which it is carried out. As regards corn, the plant most commonly used for silage in the United States, the general result of investigation appears, on the whole, to be in favor of ensiling under average conditions, so far, at least, as the extent of losses and the effect on the digestibility are concerned. It seems not unlikely, also, that the succulent silage may require relatively less labor in its mastication than the dry material, and so have a correspondingly higher value.

Preparation.—Allied to the question of the methods of preserving feeding-stuffs is that of their preparation for feeding. This may be mechanical (cutting, grinding), or in a loose sense chemical (cooking, steaming, fermenting and the like).

(1) Cutting.—The cutting of coarse fodders, aside from convenience in handling, serves chiefly to secure more complete consumption. There is no

evidence that the digestibility is increased by this manipulation or that the work of mastication is materially lessened. Even very fine grinding of straw has been shown not to affect its digestibility. That it did diminish the work of mastication, while interesting in its theoretical bearings, is hardly of much practical significance.

(2) Grinding.— The grinding of grain, on the other hand, seems, at least under some conditions, to effect a material increase in its digestibility. This appears to be especially true, so far as the recorded data go, with horses and swine, while ruminants, in some trials, have digested unground and ground grains equally well. Extensive experiments with swine have also shown a distinct advantage on the side of ground feed as measured by the gain in live weight. The explanation of these facts is not far to seek. The seed-coats are intended by nature for the protection of the seed and consist of relatively insoluble, resistant substances. When grain is fed whole, a varying proportion, according to the size and hardness of the seeds, the amount fed, the species of animal, the condition of its teeth, and other factors, is likely to escape mastication and be swallowed whole. Such seeds, protected by their outer coats, are more or less imperfectly acted on by the digestive fluids, although we have no satisfactory data as to the exact extent to which they are thus protected. The loss is likely to be a variable one, although less with ruminants than with horses and swine, while the question of the profitableness of grinding involves, also, the question of cost. In the recorded experiments, the gain from grinding has varied from 3 to 14 per cent. If the cost of grinding amounts to 10 per cent of the value of the grain, its economy for healthy animals may well be doubted.

(3) Cooking.—As regards the "chemical" methods of preparing feeding-stuffs, it may be said that they do not increase the digestibility, but, on the other hand, in most cases diminish it, particularly that of the proteids. Inferior feeding-stuffs may sometimes be rendered more palatable by such treatment while a high temperature will destroy objectionable germs; but normal feeding-stuffs are rarely benefited and generally injured by such treatment, except as it may, perhaps, to some extent reduce the work of mastication. Potatoes, and possibly other starchy tubers, constitute an exception to this rule, and should ordinarily be cooked before feeding.

The classes of feeding-stuffs.

Feeding-stuffs may be grouped conveniently into three fairly distinct classes: First, the coarse fodders, or "roughage," consisting of the stalks and leaves of various crops, with or without the accompanying fruit; second, root crops, including the tubers and some fleshy fruits; third, the concentrated feeding-stuffs, often called for brevity concentrates, including the various grains and a great variety of by-products from manufacturing operations.

Coarse fodders.—The coarse fodders are characterized chemically by a relatively large percentage of crude fiber, which forms the framework of the plant. They usually do not contain very much protein, although in some this ingredient shows a fairly high percentage. The proportion of crude fat is small and includes much besides true fat. The nitrogen-free extract, along with more or less starch and sugar, includes a great variety of less familiar carbohydrates and of other substances whose nutritive value is problematical. By far the larger proportion of the coarse fodders in common use is supplied by two classes of plants,—the grasses (Gramineæ), including corn, and the legumes (Leguminosæ). Furthermore, crops belonging to both these classes may be used for fodder when but partially mature (hay, corn, forage), or they may be allowed to ripen, the grain may be removed, and the residue (straw, stover) used for feeding.

(1) The grasses.—The larger share of the hay crop and of the pasturage of the United States is supplied by plants known in a restricted and popular sense as grasses, such as timothy, blue-grass, red-top. To these must be added, as a most important source of forage in the United States, corn, which botanically is a grass, although not commonly so called. The forage supplied by these plants has a very wide range of nutritive value, depending on a variety of conditions. Chief among these is the stage of maturity at which the crop is utilized. In young, growing vegetation the cell walls are thin and consist of nearly pure cellulose, while the cells are filled with active protoplasm whose chief ingredients are proteids. Hence, forage cut at this stage shows a relatively low percentage of crude fiber and a high percentage of proteids. Young and tender pasture grass, relatively rich in proteids and low in crude fiber, may even approach the concentrated feeds in value, as illustrated by the following comparison of the dry matter of a sample of young pasture grass with that of average oats:

	Pasture grass		Oats	
	Percentage composition	Digestible matter	Percentage composition	Digestible matter
Ash	9.23	. .	3.37	
Crude protein	21.89	13.42	13.26	10.39
Crude fiber	18.25	46.06	10.67	54.32
Nitrogen-free extract	44.39		67.08	
Ether extract	6.24	3.59	5.62	4.70

As the plant matures, the cell walls grow thicker and become more and more impregnated with tough, woody material. At the same time, more soluble carbohydrates, as starch and sugar, are being produced while the protoplasm comes to occupy but a small part of the cell. The fully mature forage, therefore, is rich in crude fiber of

a tough, resistant sort, contains much carbohydrate material in general and tends to be poor in proteids. For example, three samples of meadow-grass, cut at different dates, had the following composition, reduced to a uniform percentage of water:

	May 14	June 9	June 26 (over-ripe)
Water	15.0	15.0	15.0
Ash	7.7	6.8	6.2
Crude protein	16.1	9.5	7.2
Crude fiber	21.0	29.6	32.4
Nitrogen-free extract	37.3	36.8	36.9
Ether extract	2.9	2.3	2.3
	100.0	100.0	100.0

Accompanying this change in composition goes a decrease in digestibility. In the first place, the crude fiber becomes more resistant to the action of the digestive organs. In these three samples, out of each 100 parts of crude fiber present there were digested 79.5 parts, 65.7 parts and 61.1 parts respectively. Furthermore, the less soluble crude fiber seems to have a tendency to protect the contents of the cells from digestion. At any rate, the percentage digestibility of the proteids, and, to a less degree, that of the other ingredients also suffers. The percentage digestibility of the several ingredients of the above samples of grass, omitting the ash, was found to be as follows:

	May 14	June 9	June 26
Crude protein	73.3	72.1	55.5
Crude fiber	79.5	65.7	61.1
Nitrogen-free extract	75.7	61.9	55.7
Ether extract	65.4	51.6	43.3

The percentages of total nutrients, expressed in the ordinary way, were therefore:

	May 14	June 9	June 26
Digestible protein	11.8	6.8	4.0
Digestible carbohydrates	44.9	42.3	40.3
Digestible ether extract	1.9	1.2	1.0

No determinations of the energy values of these samples were made, but it may be fairly assumed that the increasing woodiness not only diminished the total amounts of digestible nutrients contained but also increased the relative expenditure of energy in digestion and assimilation, so that the lesser amount of digestible matter in the more mature samples was probably less valuable per unit than that of the younger samples.

When the seeds of grasses begin to form, there is a rather rapid transfer of nutritive materials to them from the stalks and leaves. The seeds of the ordinary hay grasses, however, are so small and so well protected by their seed-coats that they either shell out and are lost or largely escape mastication and digestion. Grass harvested after the seeds have formed practically furnishes straw rather than hay.

The bearing of the foregoing facts on the much discussed question of the best time to cut grass for hay is obvious. The highest quality is secured by very early cutting, but at a great sacrifice as to quantity. The greatest total dry weight of crop is usually secured by allowing it to stand until mature, but the result of the low digestibility, as well as the lack of palatability of the product, is that the amount of real available food material secured is less than if the crop had been harvested earlier. As a general rule, and subject to many modifications, it may be said that the greatest yield of digestible food will usually be secured by cutting grass not later than when in full bloom. The hay thus secured will be less rich in digestible protein than that cut earlier, but richer in non-nitrogenous materials. When conditions are such as to make more than one cutting in a season economically possible or desirable, an earlier date for the first cutting may be preferable, yielding a higher quality of hay and leaving more time for the growth of the second crop.

A somewhat important exception to the general rule regarding the influence of maturity is observed in the case of corn. While advancing maturity produces its normal effects on the stalks and leaves, such large amounts of easily digestible material are stored up during ripening in the grain, and the latter makes up so large a percentage of the total weight of the crop that it outbalances the effect of increasing maturity, and the ripe or nearly ripe crop, taken as a whole—i. e., as used for silage or as field-cured forage—is more digestible than at earlier stages of growth. For example, the dry matter of corn forage at three different stages had the following composition and digestibility:

	Percentage composition			Percentage digestibility		
	Silking	Kernels glazing	Nearly mature	Silking	Kernels glazing	Nearly mature
Ash	7.33	3.57	3.45		4.9	34.8
Proteids	8.99	7.08	7.65	58.8	46.4	63.1
Non-proteids	4.77	1.30	0.47	88.0	79.6	35.7
Crude fiber	27.04	16.88	16.03	67.7	40.0	47.2
Nitrogen-free extract	48.28	67.15	68.69	71.2	76.8	81.2
Ether extract	3.59	4.02	3.71	74.3	84.8	82.2
Total dry matter	100.00	100.00	100.00	64.2	66.3	72.6

On the other hand, of course, the digestibility of the stalks and leaves alone (stover) diminishes as in the case of other grasses as the plant grows older.

The composition and digestibility of the grasses is also materially affected by the proportions of the various vegetative organs. The influence of the large proportion of seed in the corn plant has already been mentioned. In general, the leaves of the grasses, and of other forage plants as well, are more tender and contain less crude fiber and more proteids than the stalks. Leafy species and varieties therefore tend to have a higher feeding value than those which consist more largely of stalks, and any influences, such as thickness of planting, manuring, season, and the like, affecting the relative proportion of leaves, tend also to affect the value of the crop. The combined result of all these factors is to make the composition of grass, or of the hay or silage made from it, extremely variable. American analyses of timothy hay, for example, show total protein ranging from 3.8 per cent to 9.8 per cent and fiber varying from 22.2 per cent to 38.5 per cent. The corresponding variations in hay from a few other grasses are as follows :

	Total protein	Crude fiber
	Per cent	Per cent
Red-top	5.9–10.4	24.0–31.8
Kentucky blue-grass .	5.3–12.9	17.7–26.8
Meadow fescue . . .	4.5–11.8	20.8–31.9
Orchard-grass . . .	6.6–10.4	28.9–38.3
Corn forage * . . .	2.7– 6.9	7.5–24.7
Oats	5.2– 9.5	23.1–30.9

* Entire plant, usually containing considerably more water than hay

That these variations in composition are accompanied by corresponding differences in digestibility has already been pointed out. Moreover, the percentage of crude fiber in coarse fodders has been found to be a fairly accurate index of the relative expenditure of energy in digestion. Not only does coarse, woody forage contain less digestible matter, but what it does contain is less valuable to the animal, pound for pound, than that derived from forage of a better quality.

(2) The legumes — the clovers, alfalfa, peas, beans, vetches, and the like—constitute a source of forage second only to the grasses in importance, while their value as renovating crops gives them a peculiar position in agriculture. Broadly speaking, leguminous forage may be said to differ from that of the grasses in two main points. First, under like conditions it is notably richer in proteids than the latter. Second, there is a more marked difference between the physical properties of the stems and the leaves in the legumes, the rather coarse stems increasing relatively to the leaves with advancing maturity. Hay from somewhat mature legumes is therefore likely to be bulky, to have a higher percentage of crude fiber than grass hay, and relatively to be less digestible. For the same reason it is more subject to mechanical losses in curing, which likewise lower its quality. For all these reasons, the composition and digestibility of leguminous forage show an even greater range than those of the grasses, and the importance of timely cutting is still more marked. In brief, the influences which affect the composition and digestibility of the grasses affect those of the legumes in substantially the same way but to an even greater extent.

(3) Straw consists of the vegetative organs of the plant after the removal of the ripe or nearly ripe seeds. Since the ripening of the seed consists largely in the transfer to it of soluble materials from the leaves and stems, it follows that the straw will be poor in digestible materials in proportion to the extent of seed formation and the degree to which the seeds ripen. Furthermore, those parts of the plant most distant from the seed are found to be most completely exhausted of food material. The straw of the common small grains is relatively very poor in proteids and fat, while still containing not inconsiderable amounts of digestible carbohydrates and related substances. Its tough, woody character, however, as indicated by its high percentage of crude fiber, makes necessary a relatively large expenditure of energy in its digestion, and its real nutritive value is therefore low. Wheat- and rye-straw stand at the foot of the list, while oat- and barley-straw are more valuable. Sheep are especially adapted to utilize straw, consuming the upper and more valuable parts and rejecting the coarser parts. The straw of corn (stover) constitutes a valuable feeding-stuff. It is relatively less woody than that of the small grains, has a relatively high degree of digestibility, and is more palatable than ordinary straw. To secure its complete consumption, however, it is necessary to cut or shred it, and it has been questioned whether the additional material eaten in the cut fodder is worth the labor of cutting. That it contains much digestible matter is undoubted, but no determinations of the work of digestion have yet been made. The straw of the legumes is richer in protein than that of the cereals and lower in fiber, with correspondingly higher digestibility. On the other hand, it is usually coarse and unpalatable, and liable to contain molds and other fungi.

Roots and tubers constitute a distinct class of feeding-stuffs, differing markedly in their properties from the coarse fodders on the one hand and the concentrated feeding-stuffs on the other. With them may be included for convenience certain fruits, notably pumpkins and other cucurbita. They are characterized especially by their large proportion of water. In the root crops proper (beets, turnips, carrots, mangels and the like) the percentage of water may vary from 80 to 95. The tubers (of which potatoes are the chief representative) contain less water, the range being approximately 66 to 82 per cent. A second equally marked characteristic of these feeding-stuffs is the low percentage of crude fiber in their dry matter. Their percentage of crude protein is also low, and a large share of it consists of non-proteids (so-called amides) of inferior nutritive value. The dry matter of these crops consists largely of the more readily

soluble carbohydrates. In the tubers starch is the predominant carbohydrate, while in beets, especially sugar-beets, cane-sugar occupies this position, and this substance has been shown to have a distinctly lower nutritive value, for ruminants at least, than starch. In other root crops, the carbohydrates consist largely of gums, pectin substances, and other compounds, including the so-called pentose carbohydrates, whose exact nutritive value is still uncertain. There are also present in roots, and particularly in fruits, more or less organic acids whose nutritive value is low. In consequence of their succulent and tender nature, tubers, and especially roots, have a high degree of digestibility and require little energy for their digestion. They are therefore a valuable source of carbohydrate material, even though some of their ingredients are of somewhat inferior value. In general, the dry matter of tubers is more valuable than that of roots. On the other hand, the dietetic effects of roots are especially prized, but the considerable amount of labor required for their cultivation tends to restrict their use.

The concentrated feeding-stuffs, or "concentrates," as their name implies, are those which contain a large amount of nutriment in a small weight and bulk. They stand in contrast, on the one hand, with the coarse fodders, in which the real nutriment is accompanied by a large proportion of woody fiber and other indigestible matter which adds to the weight and bulk and to the work of digestion without materially increasing the nutritive value. On the other hand, they excel the roots and tubers because, while the dry matter of the latter is very valuable, it is largely diluted, so to speak, with water. The concentrates are therefore the main reliance for the rapid, intensive production of meat, milk or work. The concentrated feeding-stuffs may be subdivided into (1) the grains and (2) the by-product feeding-stuffs.

(1) *The grains* were, until comparatively recent times, the main reliance of users of concentrated feed, and indeed are still in many sections of the United States. Corn, oats, barley, rye, peas, beans, rice and at times even wheat, are feeding-stuffs whose value needs no advocate. These seeds contain, stored away for the use of the young plantlet, proteids, fat and carbohydrates of the most valuable character and "representing the highest type of vegetable food." Their protein is chiefly in the form of true proteids of recognized nutritive value, their carbohydrates are largely starch, and their ether extract chiefly true fat. Being closely related to the nutrition of the young plant, the composition of the properly matured seed shows much smaller variations than that of the coarse fodders. The degree of maturity of the seed, however, materially affects its composition and in much the same way as it does that of the coarse fodders. In the early stages of seed formation, the proteids and ash flow abundantly from the vegetative organs to the seed, while later the ripening of the seed is largely an accumulation of carbohydrates. Any influences, therefore, which check the normal development of the seed, such as drought and lodging of the grain, tend to produce a seed richer in protein and poorer in carbohydrates. Light, shriveled grain, therefore, tends to be high in proteids. Moreover, the ingredients of unripe seeds differ to a considerable extent from those of ripe seeds. The crude protein, for example, is to a larger extent in the form of "amides" rather than true proteids, and the carbohydrates are in the form of sugars of one sort or another rather than starch, as in the ripe grain.

The cereal grains are characterized by a medium percentage of protein (8 to 14 per cent) chiefly composed of true proteids, a rather low percentage of fat (1.5 to 6 per cent) and a high percentage of carbohydrates, largely starch. Their ash is small in amount and in it potash and phosphoric acid are prominent, while but little lime is found. Corn contains rather less proteids than the other cereal grains, with correspondingly high percentages of starch and of fat. While it has been shown that the proteid content of corn can be notably increased by selection and breeding, the effects of the latter have not yet sensibly affected the character of the commercial crop. The naked grains (corn, rye, wheat) show a comparatively high percentage digestibility, and both in this respect and as regards their composition exhibit less variation than the hulled grains (oats, barley). In the latter, the variable proportion of the relatively valueless hulls to the kernel causes both composition and digestibility to vary greatly. Oats, for example, have shown the extremes of 6 and 17 per cent protein and 3 to 7 per cent of fat. The hulls resemble straw in composition and value. They therefore increase the proportion of crude fiber in the grain, and correspondingly diminish its digestibility and nutritive value. The place of the cereal grains in feeding practice is clearly indicated by the foregoing statements. They enable the feeder to introduce into his rations, without unduly increasing their bulk or weight, large amounts of easily digestible and highly nutritious ingredients. Of themselves, they contain a fair proportion of proteids for many purposes, especially for mature animals; but they are not capable of offsetting a deficiency of proteids in the other ingredients of the ration, nor do they supply enough of this ingredient to meet fully the demands of the rapidly growing animal or the highly productive dairy cow.

The leguminous grains share the general physical properties of the naked cereal grains, and like them contain food materials (proteids, carbohydrates, fats) of the highest grade. They are especially characterized, in contrast with the cereal grains, by their relatively high percentage of proteids, ranging according to American analyses from 20 to 42 per cent. Some of them, as the soybean and the lupine, also carry notable amounts of fat, but the more common ones are not richer in this substance than the cereals. They are richer in ash than the cereals, notably as regards phosphoric acid and lime. Their digestibility is generally high. Like the cereals, they are valuable as sources of total digestible food in a concentrated

form, but unlike these they serve also to enrich rations in proteids. Aside from certain technical by-products, they are the most available materials for this purpose, and the culture of leguminous feeding crops, both for this purpose and for their effects on the soil, deserves careful consideration.

The oil seeds, such as flax, cotton and rape, are not commonly used directly as feeding-stuffs because of their commercial value. These seeds contain a high percentage of proteids, while in place of much of the carbohydrates of the cereals and legumes a large percentage of oil is found. Flax seed contains a considerable quantity of so-called "mucilage," which swells up with water to a slimy mass and has a very soothing effect on the digestive organs. Cotton seed is fed to cattle to some extent, usually either boiled or roasted, but is regarded as dangerous for growing swine.

(2) *The by-product feeding-stuffs* are the residues of technical processes by which the products of the soil are prepared for man's use, either as food or for other purposes. The more important of these technical processes are: (*a*) The milling of grains; (*b*) the manufacture of cereal foods; (*c*) the manufacture of alcoholic liquors; (*d*) the manufacture of starch and glucose; (*e*) the manufacture of sugar; (*f*) the extraction of oils.

(*a*) Milling residues, particularly of wheat, are among the most familiar of the by-product feeding-stuffs. They include the *screenings* secured in cleaning the grain for milling and the bran and middlings secured in the grinding proper. The screenings are an exceedingly variable mixture according to the quality of the grain, containing, besides light and broken grains, a great variety of weed seeds, fragments of straw, sand and earth, as well as spores of numerous fungi, and dirt of all sorts. While some of these have undoubted feeding value, the possible danger to the health of the animals, and of the infestation of the fields with weed seed through the manure, demand great caution in the use of screenings as food. Its addition to bran or middlings is to be regarded as an adulteration.

The *bran* of wheat or rye consists essentially of the seed-coats of the grain, the layer of so-called gluten cells immediately beneath them, and a proportion of the inner, floury part of the grain varying with the perfection of the milling. The seed-coats of the grain contain most of its crude fiber, while the gluten cells are richer in proteids than the inner part of the kernel. In proportion, therefore, as the bran is more perfectly separated from the flour, does it become at once richer in proteids and in crude fiber and poorer in easily digestible carbohydrates. Such bran is more valuable as a source of proteids than the more floury bran, but, at the same time, contains less total digestible matter, and probably has an inferior value as a source of energy.

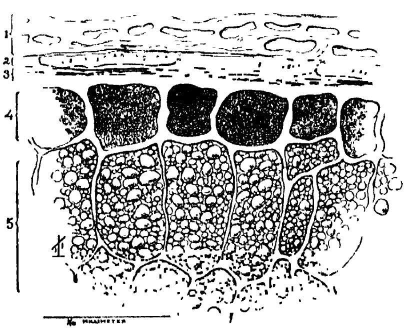


Fig. 63. Partial section of wheat kernel (enlarged 155 diameters). 1, Seed pod; 2, outer seed coat; 3, inner seed coat; 4, gluten cells; 5, starch cells. (Jordan.)

Middlings, as the name indicates, are intermediate products between bran and flour. In modern methods of milling, various grades are produced, in the names of which there is a considerable lack of uniformity. The "brown" middlings contain more of the seed-coats (bran) than the "white" middlings, which approach the low-grade flour ("red dog" flour) in character. *Shorts* seem to be substantially the same as middlings. Because of their smaller content of the hulls, middlings are decidedly more digestible than bran, while scarcely inferior to it in percentage of protein.

Buckwheat middlings, a by-product from the milling of buckwheat, contains nearly twice as much proteids and fat as average wheat middlings, and correspondingly less carbohydrates. It is sometimes called *buckwheat bran*, but this name is also applied to the tough, innutritious hulls of the buckwheat, which have little feeding-value, and which are not infrequently used as an adulterant of the middlings. The middlings are credited with a tendency to ferment or become rancid when stored in bulk, and also with producing a soft oily butter-fat when fed in large amounts.

Rice bran resembles wheat bran, but contains less proteids and fully twice as much fat. The pure bran is sold largely under the name of "*rice meal*," while the commercial "bran" contains an admixture of varying amounts of rice hulls. The hulls, which are separated from the kernel, as the first process in the milling, contain about 40 per cent of fiber, and are heavily impregnated with silica and covered with hard, silicified fibers which are liable to cause severe and even fatal irritation of the digestive organs. Their presence in the bran to any large extent is to be regarded as a dangerous adulteration. *Rice polish* results from the polishing of the rice grains after the removal of the bran and germ. It contains somewhat less fat and proteids than the pure bran, but is considerably more digestible. All these rice by-products contain more or less "*grits*" or fragments of the kernel, which have been found to be rather difficult of digestion. The rice products are also rich in fat, which becomes rancid rather easily and often renders the material unpalatable. It is asserted that this rancidity can be prevented by kiln-drying the bran or polish as soon as produced.

The tendency has been to regard the milling by-products largely as sources of proteids. While it is true that the bran and middlings are richer in proteids than whole wheat or other cereal grains, the difference is not sufficient to enable them to offset

to any marked degree the deficiencies of other ingredients of the ration in this respect. They are to be regarded primarily as sources of digestible *food as a whole, with a tendency to increase somewhat the proportion of proteids in the ration.* Familiarity with the good qualities of wheat bran in particular, its comparative safety as a feed in inexperienced hands, and its good dietetic effect have tended to an exaggerated idea of its food value. When it rules high in price it is usually possible to substitute other feeding-stuffs for it, partially or wholly, which will furnish both proteids and energy more cheaply. Buckwheat middlings, on the contrary, often furnish a cheap source of proteids for a ration otherwise deficient in it.

(*b*) In the manufacture of the great variety of so-called cereals, or breakfast foods, now on the market, a considerable quantity of by-products accumulates. In the case of the most common of

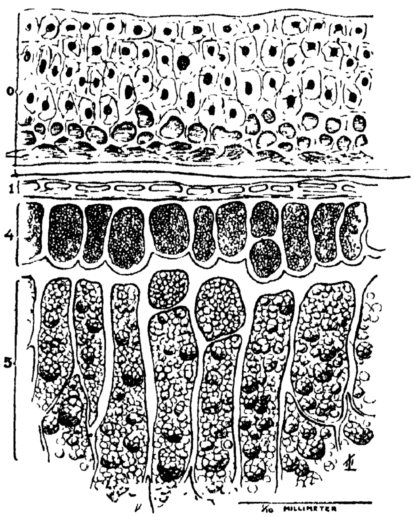


Fig. 64. Partial section of oat grain (enlarged 170 diameters). 0, Hull; 1, seed coat; 4, gluten cells; 5, starch cells. (Jordan.)

these, oatmeal, the residue consists chiefly of the hulls of the oats together with some of the lighter grains. As already noted, the hulls themselves have scarcely more feeding value than the straw, which they resemble in composition, while the proportion of light oats is not sufficient materially to raise the value. *Oat-hulls* are rarely offered as such in the market, but are usually disposed of in one of two ways. First, they are made the basis of various proprietary feeds, cheap by-products of various sorts being added, usually including a small amount of the protein-rich by-products shortly to be described. These feeds are offered under various names and with abundant advertising testimonials. While they are by no means worthless, it is evident that the oat-hulls themselves are no more valuable because of the addition to them of other materials, while the consumer ultimately pays the cost of mixing, transportation and advertising. The second use to which oat-hulls are put is the adulteration of the mixed feeds, especially corn and oat feeds, which are freely offered on the market. Since it is difficult to recognize even a considerable adulteration of this sort, such mixed feeds should *be purchased only from manufacturers of known integrity or under a satisfactory guarantee as to purity. Barley feed,* a by-product of the manufacture of pearled barley, is similar in its properties to oat-hulls for feed.

In the manufacture of hominy from corn, the hull, the germ and the more starchy parts of the kernel are rejected and constitute *hominy chop,* which is similar to the whole kernel in composition and digestibility, except that its percentage of fat is greater. Consequently it has a higher feeding value, although the fat is likely to become rancid on long keeping, and thus lower its quality.

(*c*) The manufacture of alcoholic liquors consists essentially in the conversion of the starch of grains or potatoes into sugar and the subsequent fermentation of this sugar by means of yeast. The resulting liquor may be consumed directly (beer, ale) or it may be distilled, yielding the more concentrated distilled liquors or commercial alcohol.

The first step in the process is the preparation of malt, by allowing moistened barley to germinate. The growth of the sprouts is stopped by drying when they are about one-third inch long, and these dried sprouts, separated from the grain, constitute *malt-sprouts.* Being young roots of barley, they have the general properties of all young plant-growth, containing a high percentage of crude protein, much of it in the form of amides, and a low percentage of crude fiber. The next step in the process is the mashing of the ground malt and other grain with warm water. In this process, the ferment of the sprouted barley acts on the starch of the grain, transforming it into sugar. In the manufacture of beer or ale, the resulting liquid is drawn off and fermented separately, leaving a residue known as *brewers' grains,* which is used extensively as a dairy food. In the fresh state it is a valuable food, but is subject to the disadvantage of fermenting or souring very readily, and tending in this state to injure the quality of the milk. Somewhat recently, economical processes for drying it have been perfected, and the dried brewers' grains constitutes a valuable feed which can be shipped like any other dried feed. In the preparation of distilled liquor or alcohol, the liquid is fermented in contact with the grains and the alcohol then distilled off, leaving a residue known as *distillers' grains* or *distillery slop.* This residue is much wetter than brewers' grains, but is less subject to fermentation, since the sugar has been more completely removed. Large quantities of it are now put on the market in the dried form, both under its own name and various trade names, some of which, such as "*Ajax flakes,*" "*Atlas gluten meal*" and the like, contain no suggestion of the real nature of the material. It constitutes a valuable source of stock-food. The grains produced from rye are regarded as the poorest and those from corn as of the best quality. In all these processes the object is to convert the starch of the grain as completely as possible into sugar and then into alcohol. This results

in increasing the percentage of all the other ingredients in the residue. They contain accordingly a high percentage of proteids with also a somewhat greater percentage of crude fiber than the ordinary grains. They serve, therefore, not only to supply food as a whole, but also to correct a deficiency of proteids in the ration.

(*d*) Starch and glucose are made in the United States chiefly from corn. The starch is separated by coarse grinding and the use of water, the starch

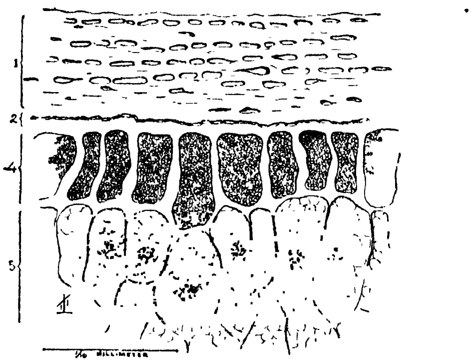


Fig. 65. Partial section of maize kernel (enlarged 170 diameters). 1, Outer layer of skin; 2, inner layer of skin; 4, gluten cell; 5, starch cells. (Jordan.)

being carried off in suspension and allowed to settle out. Glucose is manufactured by further treatment of the starch with acid. In the preparation of the starch, the parts of the kernel which are rejected are the hull, the germ and the more glutinous part of the interior of the grain from which the starch cannot be completely separated. The hulls are comparatively low in proteids and contain considerable fiber. When sold separately they are called *corn bran,* although the composition of commercial samples indicates some admixture of the germs. The germ contains about 30 per cent of oil, which has a commercial value and is secured by pressing the germs. The residue constitutes *germ meal,* which still contains about 7 per cent of oil, and in the neighborhood of 11 per cent of crude protein. The glutinous residue of the kernel constitutes *gluten meal,* containing, in general, 30 to 40 per cent of crude protein with a comparatively low percentage of fat and fiber. Some factories mix the gluten meal and the hulls, and sell the mixture under the name of *gluten feed,* which contains approximately 24 per cent of crude protein, 6 per cent of crude fiber and 6 per cent of fat. Sometimes the hulls and germs are sold together under the names "*sugar feed*" or "*starch feed,*" either wet or dry. In fact, various mixtures of the three main products are made and sold under diverse commercial names. These various glucose products should invariably be purchased on a guarantee as regards composition and purity.

(*e*) Sugar has come to be manufactured from sugar-beets to a considerable extent in the United States. The sugar is extracted from the finely cut beets by means of water in what is known as the diffusion process. The residue from this constitutes what is commonly known as *beet pulp,* which is essentially sugar-beets minus the sugar and some of the other soluble substances. In the fresh state it contains 90 to 95 per cent of water, which may be reduced to about 85 to 87 per cent by pressing. Its general properties are similar to those of roots and it occupies much the same place in the ration. Its digestible matter consists chiefly of carbohydrates belonging to the group of pectins and gums, somewhat inferior to the sugar of the beets, but according to recent investigation fully as valuable as the digestible matter of mangels. The wet beet pulp is too heavy to bear long transportation, but may be preserved in the neighborhood of the factory by ensiling. It is now, however, dried and put on the market as dried beet pulp, containing not more than 5 to 10 per cent of water. The dried pulp is relatively about equally valuable with the wet pulp, especially if soaked in water, as it should be before feeding.

In the further manufacture of sugar either from sugar-beets or sugar-cane, there remains, as a final residue, the *molasses.* This contains 20 to 25 per cent of water, approximately 50 per cent of sugar, scarcely more than one-half per cent of true proteids, and 8 to 10 per cent of so-called non-proteids, along with other substances of doubtful nutritive value. It is essentially a source of easily soluble carbohydrates, principally sugar. Beet molasses, in particular, has a marked laxative action, commonly ascribed to the potash salts present in it but perhaps due quite as much to the sugar. For this reason, care is required to accustom animals to it gradually and not to over-feed with it. Its laxative qualities are said to be valuable when used in small amounts for horses in preventing attacks of colic. Owing to its physical properties, it is an inconvenient material to handle. To avoid this difficulty, the so-called *molasses feeds* have been put on the market. These consist of molasses dried down on some suitable material. A large number of concentrated feeding-stuffs have been used for this purpose, and it has also been dried together with the beet pulp, forming the so-called *molasses pulp.* All these feeds are of value in proportion to the materials out of which they are made.

(*f*) The extraction of commercial oils from various oil-bearing seeds leaves by-products, called *oil-cake* or *oil-meal,* some of which have a high feeding value. Of these, *cottonseed* and *linseed meal* are the only ones extensively used in the United States and are typical of the others. The seeds of cotton and flax are rich in both fat and proteids. Hulled cottonseed contains about 30 per cent of each and flaxseed about 22 per cent proteids and 35 per cent fat, the latter percentage, however, being somewhat variable. The oil is extracted from the seeds either by pressure or by the use of solvents, leaving a residue still containing some fat and very rich in protein. At present cotton oil is extracted only by pressure, the resulting hard cake being ground to cottonseed meal. The highest grade of cottonseed meal is made from the hulled seed and contains 40 to 42 per cent of crude pro-

tein and 7 to 9 per cent of fat. It should be practically free from the hulls and therefore contain little crude fiber. Cottonseed meal is adulterated extensively with the tough, black hulls of the cottonseed, which have a very low feeding value. This is especially true of the inferior grades of commercial cottonseed meal, which are sold at a lower price than the standard grade.

Linseed oil is extracted from the flaxseed both by pressure and by means of naphtha, the latter being completely removed from the resulting oil-meal and recovered for use again. The "new process" of extraction removes the fat more completely than the "old process" of pressure, and the resulting linseed meal is somewhat poorer in fat and contains somewhat more protein than the *old-process meal.* The process of extraction by pressure has been so far perfected in recent years, however, that the difference between the old-process and *new-process meal* is distinctly less than formerly. The protein of the new-process meal appears to be slightly less digestible than that of the old-process meal, which tends still further to reduce the difference between the two.

The *corn-germ meal* mentioned in connection with the gluten feeds may also be classed as an oil-meal.

III. Feeding

The details of the practice of feeding are considered in connection with the discussion of the various animals, in a subsequent part of this work, and only the principles involved are taken up here. The practice of feeding is now modified and simplified by many machines that prepare the food, some of the types of which are shown in Figs. 77 to 103. These figures may suggest devices for particular needs; but it is not the intention to recommend any particular machine.

Maintenance requirements.

As shown earlier in this article, the animal body is comparable in some respects with a heat motor in that it is a converter of energy. It applies the proteids of its food to maintain its bodily machinery in repair, while it utilizes the available energy of its food, first, to keep the bodily machinery in operation, and second, to produce external work or material products. As in the case of an engine, a certain expenditure of fuel is required to keep the machine running when it is doing no visible work. In other words, as common experience shows, an animal requires food even when idle and producing nothing. The amount required just to prevent the body consuming its own tissues is called the maintenance requirement. The word maintenance, therefore, is used in a restricted sense and not, as it sometimes is in common parlance, to indicate the total amount of food required by a working horse or beef animal. The actual feeding of animals simply to maintain them is not usually economically desirable, and when it is, observation usually suffices to determine whether the ration consumed is adequate. The importance of the maintenance requirement lies in the fact that a considerable proportion of every productive ration is consumed in simple maintenance, and that it is therefore important to know what proportion is thus used and what part remains available for productive purposes.

The maintenance requirement includes the demand for proteids and for energy. The proteid tissues of the animal are constantly breaking down and wearing out even in a state of rest. It is probable that the amount so broken down when no food is given represents the smallest amount on which the animal can be maintained. It is impracticable to apply this test to domestic animals, however, and their maintenance requirements as regards proteids must be ascertained by direct experiment.

As regards the energy requirements for maintenance, the case is similar. Were the animal deprived of food, the energy required for its vital activities would be supplied by the burning up of tissue and there would be a loss of the latter. The maintenance ration must be sufficient just to prevent the loss that would occur without food. In other words, it must contain energy available for maintenance in amount equal to that which would otherwise be supplied by the breaking down of tissues. The most logical method of stating the maintenance requirement, therefore, is in terms of net available energy, or "maintenance values." Unfortunately, however, as we have seen, the maintenance values of only a few feeding stuffs have been determined. Most of the results of experiments thus far have been expressed in terms of total digestible matter or of fuel values, and for the present this seems the most practicable method of statement.

Influence of kind of feeding-stuff.—As we have seen, the fuel values of different feeding-stuffs are not equally available for maintenance because of differences in the amount of energy expended in digestion and assimilation. It follows, therefore, that with the same animal under identical conditions the amount of food required exactly to maintain it will differ according to the degree of availability of the energy of the food. For example, according to the figures previously given, to prevent a loss of 100 Calories from the tissues of the animal would require a fuel value of $\frac{100}{.63}=159$ Calories in timothy hay but only of $\frac{100}{.78}=128$ Calories in corn meal. Since the energy of concentrated feeds is more available than that of coarse feeds, the larger the proportion of the former in the ration the less will be the amount of digestible matter or of fuel value required for maintenance. Conversely, the more of the difficultly digestible feeds the ration contains the larger will be the apparent maintenance requirement.

Influence of size of animal.—It is obvious that the maintenance requirements of different animals of the same species will vary with their size or weight. It has been shown, however, that the amount of energy required for the vital activity of the fasting animal is approximately proportionate to the amount of surface exposed by the animal. This being the case, the amount of any given feed actually required for maintenance will also

be proportional to the surface of the animal. We cannot measure readily the surface area of an animal, but since animals of the same species are approximately of the same shape, it follows from a well-known geometrical principle that their surfaces will be nearly proportional to the squares of the cube roots of their weights, and the maintenance requirement may be safely computed on this basis for similar animals. The increase in weight of a fattening animal also causes the maintenance requirement to increase, and, as it would seem, more and more rapidly as the completion of the fattening is approached.

Temperature.—The temperature of the animal's surroundings may also influence, to a certain degree, the maintenance requirement, although not to the extent often supposed. The primary object of the maintenance ration is to supply energy to keep the animal machinery in action, and, in a sense, the production of heat is incidental. While only part of the fuel value of the food is available for actual maintenance, it is all finally liberated as heat, arising in part from the work of digestion and in part from the oxidation of the available part of the food. At moderate temperatures, the heat thus produced may be enough or more than enough to maintain the temperature of the body, while at low temperatures it may be insufficient. At the lower temperature, then, the animal must receive additional food simply to keep it warm or it will burn up its own tissues for that purpose, while above a certain point the heat supply arising from the consumption of the maintenance ration will be ample, and the maintenance requirement will not be affected by changes of temperature. The data now accessible render it probable that with our common domestic animals it is only at a rather low temperature that extra food is required simply for heat production.

Maintenance requirements of cattle.—The results of earlier experiments on the maintenance requirements of cattle, as well as the feeding standards based on them, have in recent years been shown to be entirely too high. The data given below are based on more recent experiments at the Pennsylvania Experiment Station and the experiment station at Moeckern in Germany.

(1) Proteids.—In nine experiments by the German investigators, the smallest amount of digestible crude protein which sufficed for maintenance for a 1,000-pound animal was .65 pounds. The experiments at the Pennsylvania Experiment Station have given somewhat lower figures, namely about .4 pounds of true proteids. As was pointed out in considering the digestibility of the food, however, rations very low in proteids tend to suffer as regards their digestibility. Since it is comparatively easy to supply abundance of proteids for maintenance in the ordinary coarse fodder of the farm, particularly if legumes are available, it is probably safe to increase the figures in case of actual maintenance feeding to 0.5 or 0.6 pounds true proteids.

(2) Energy.—The following tabulation shows the fuel value required for maintenance according to the earlier Pennsylvania experiments, the Moeckern experiments, and the later Pennsylvania experiments.

PER 1,000 POUNDS LIVE WEIGHT

Earlier Pennsylvania experiments . . .	12,320 Cals.
Moeckern experiments	10,900 Cals.
Two later Pennsylvania experiments . .	11,430 Cals.

In the case of a ration consisting as largely as possible of grain, the earlier Pennsylvania experiments give a result in accordance with the theoretical considerations already mentioned, the fuel value of the maintenance requirements per 1,000

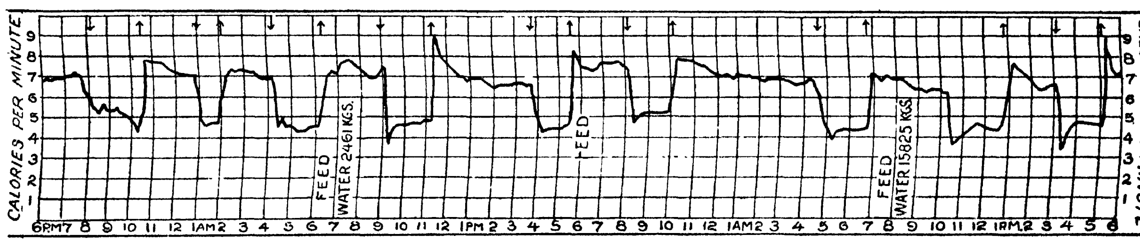


Fig. 66. Rate of heat emission. The arrows indicate when the animal stood up and lay down.

pounds live weight being 9,860 Cals., or 2,460 Cals. less than the average of the experiments with the same animals on coarse feeds exclusively. This difference, therefore, may be considered fairly to represent the possible range in the maintenance requirement if we exclude rations consisting of very indigestible materials.

The two later experiments (with the respiration calorimeter) at the Pennsylvania Experiment Station gave as the net available energy required for maintenance per 1,000 pounds live weight, 7,350 Cals. Since these two experiments agree well with the others as regards the fuel values required with

Individuality.—Considerable differences have been observed in the maintenance requirements of different individuals of the same species on similar feed and under like conditions. It seems probable that much, at least, of this variation is due to differences in the temperaments of the animals. Restlessness, that is, muscular activity, has been shown to have a very marked effect on the rate of oxidation in the body, while the mere effort of standing in the case of cattle may increase the metabolism by 30 to 50 per cent. Obviously, the maintenance requirement of a quiet animal will be considerably less than that of a restless one.

similar feeds, we may probably consider the above figure to represent with a fair degree of accuracy the maintenance requirement in terms of available energy.

Maintenance requirements of sheep.—The maintenance ration of sheep necessarily includes the amount required for the growth of wool, and to this extent departs from the strict definition of the maintenance ration previously given.

(1) **Proteids.**—As regards proteid requirements, few definite data are on record. It is clear, however, that it must be relatively greater than in the case of cattle, since the wool fiber is essentially proteid. The amount of proteids in the average daily growth of wool per 1,000 pounds live weight may be said in general terms to range from .1 to .2 pound. If we were to assume that the remaining demand for proteids was comparable with that of cattle, we should have a total of .6 to .8 pound per 1,000 pounds live weight, but there are indications that the figures for sheep should be placed materially higher. Several experiments in which 1.1 to 1.3 pound of digestible crude protein, per 1,000 pounds live weight, was fed have shown that these amounts were sufficient when the total amount of the ration was adequate, while some of them at least indicate that the lower figure named is about the minimum. These figures refer, as stated, to crude protein. If we state the requirement at, say one pound of true proteids per 1,000 pounds live weight, we shall probably be safe.

(2) Energy.—As regards the energy requirement, a larger number of results are on record, although they are based chiefly on live-weight experiments. Two respiration experiments, after allowing as accurately as possible for the small gains made, give an average of 1,420 Cals. fuel value per 100 pounds live weight for maintenance. The average of three series of live-weight experiments is decidedly higher, namely, 1,761 Cals. If we average these two figures (thus giving double weight to the respiration experiments) we obtain 1,591 Cals., or in round numbers 1,600 Cals. This amount covers the actual growth of the wool as well as the requirements for maintenance of the body. All the experiments were chiefly or exclusively on coarse fodder. When much grain is fed, the figures, as in the case of cattle, are lower.

These results make it clear that, in proportion to its surface, the sheep requires less for maintenance than cattle. Thus, if we compute the maintenance requirement for sheep per 1,000 pounds in proportion to the square of the cube root of the live weight, we obtain 7,385 Cals. in place of approximately 11,000 Cals. required for cattle. The cause of this difference is not clear. It can hardly be attributed to the immediate influence of the wool, because, as already stated, domestic animals are ordinarily producing an excess of heat and the maintenance demand represents the requirements of the body for energy and not for heat. It is another question whether, in the course of its development, the sheep may not have adjusted its internal work to the lessened heat radiation due to its thick coat.

The consideration of the maintenance requirements of the sheep leads naturally to the question of the influence of food on wool production. In considering this question, it is necessary to distinguish between the growth of the pure wool fiber and the production of fat and other materials which accompany it in the crude wool. In brief, it may be stated that partial starvation or lack of sufficient proteids in the food decreases the rate of growth of the wool fiber but does not stop it entirely. A liberal maintenance ration ensures the normal growth of the wool, but heavy feeding in excess of this has not been found to increase the growth of the pure wool fiber, although it may increase the total weight of the fleece.

Maintenance requirements of swine.—Scarcely any data are on record as to the maintenance requirements of swine, either as regards proteids or energy. Two respiration experiments showed a consumption of tissue during fasting equivalent to about 1,200 Cals. per 100 pounds live weight, and accordingly this would indicate the amount of net available energy required to support the animal. Since, however, we have no satisfactory data as to the maintenance values of foods for swine, the above figures are at present of little practical significance.

Maintenance requirements of the horse.—(1) Proteids.—As regards the proteid requirements of the horse for maintenance, no definite data are available. Since the working animal must have a well-developed and well-nourished muscular system, it may be presumed that the proteid requirements are somewhat greater than for the maintenance, for example, of a beef- or milk-producing animal. The question of the proteid requirement, however, can be considered most profitably in connection with the discussion of the feeding of working animals.

(2) Energy.—The energy requirement for maintenance is somewhat less readily determined in the case of the horse than with cattle, owing to the more nervous nature of the horse. Food supplied in excess of maintenance is likely to lead to restlessness and unnecessary activity in the stall, so that a ration might simply maintain the weight of the animal, yet be greater than was absolutely necessary for this purpose. By comparing the amounts of food required to enable the horse to perform two different amounts of work, Wolff was able to figure back to the amount necessary if no work had been required. In this way he found that the amount of food required for maintenance varied with the proportion of crude fiber contained in it, as did also its value for work production, the maintenance requirement per 500 kilograms (1,100 pounds) live weight varying from 7.30 pounds to 10.24 pounds of total digestible matter (including the fat, multiplied by 2.4). In other words, it was found, exactly as in the case of cattle, that the coarser and more woody feeding-stuffs were less efficient for maintenance. Wolff found further that if he omitted the crude fiber entirely from his computations his results for the maintenance requirement agreed very satisfactorily, averaging 7.27 pounds of fiber-free digestible nutrients per 500 kilograms live weight. In other words, the

expenditure of energy in digestion and assimilation seemed to be proportional to the crude fiber. It is to be noted, however, that but a limited variety of feeds was used in these experiments. Muntz and Grandeau have reached a maintenance requirement similar to Wolff's by placing the horse on a ration insufficient for maintenance and then gradually increasing it until equilibrium was reached.

Fig. 67. The "marbling" of meat.

Zuntz and Hagemann, after correcting what they regard as errors in Wolff's method of calculation, compute the average maintenance requirement from his experiments as 8.32 pounds digestible matter per 500 kilograms live weight, this including the crude fiber. From one of their own experiments with a ration containing less crude fiber they obtain a requirement of 7.20 pounds. These amounts are equivalent, respectively, to 14,950 Cals. and 12,930 Cals. of fuel value, the greater amount being required with the coarser and more woody food. Computing the work of digestion and assimilation according to their method, and subtracting it from the fuel value of the ration, they find the amount of available energy to be very nearly the same in the two cases, averaging 7,920 Cals. Accordingly, a ration containing, according to the table of "Available Energy per Pound for the Horse" (page 66) previously given, the above-named amount of available energy would be a maintenance ration for a 500-kilogram horse. Zuntz and Hagemann, however, present evidence to show that a considerable share of this represents energy required to produce heat to maintain the temperature of the body. When the horse is doing work on a medium or heavy ration, however, it has abundance of heat from other sources, and this part of the maintenance ration is not needed. They estimate the actual demand for energy for the internal work of the body at 4,356 Cals. per 500 kilograms live weight, and make this the basis of their computations of rations.

Meat production.

By meat, in the general sense of the term, is meant the edible part of the carcass. This part is made up of the adipose tissue and of the lean meat, or meat in the narrower sense of the term. The adipose tissue, commonly spoken of as the fat, is not pure fat, but consists of cells of connective tissue which have become loaded with fat and contains 85 to 90 per cent of pure, dry fat, the remainder consisting of the proteid material of the connective tissue together with the accompanying ash and water. Adipose tissue is chiefly found immediately beneath the skin and about the internal organs, but smaller masses of it are scattered throughout the body. The lean meat is practically equivalent to muscular tissue. The essential part of the muscles consists of various proteids, together with accompanying ash ingredients and a large percentage of water. In addition, the lean meat, as ordinarily met with, always contains more or less fat tissue, which, if abundant, produces the well-known marbling of the meat. For example, the lean meat of an unfattened steer twenty-seven months old had the following percentage composition:

Water	70.09
Ash	.95
Protein	19.30
Fat	9.66
	100.00

In other words, of the dry matter of this meat about two-thirds was protein and something less than one-third fat. The water of lean meat is associated with the proteids, the fat tissue containing little.

Growth and fattening.—Two tolerably distinct processes are involved in meat production, namely, growth and fattening. Growth may be said to consist substantially in an increase of the proteid tissues of the body, including, of course, not merely the muscles but the bones, ligaments, cartilage and connective tissue. Fattening, on the other hand, as its name implies, is simply the more or less rapid formation of adipose tissue, which does not form a necessary part of the structure of the body. As related to meat production, it is essentially an improvement in the quality of the product by the accumulation of fat tissue between the fibers of the lean meat and incidentally in other parts of the carcass. Obviously, no line can be drawn between the two processes. The growing animal produces more or less fat on a liberal ration, while fattening is often effected with animals which have not fully completed their growth. At the same time, there is a clear distinction between the two, as indicated by the fact that they are often undertaken by different individuals.

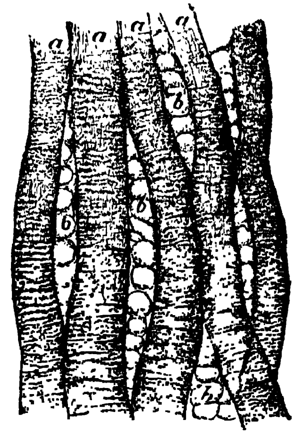


Fig. 68. Fat-cells in muscle.

Rate of growth.—Growth is evidently the fundamental factor in meat production, since it consists in an increase of the essential constituents of the

meat. In this process, age is the chief determining factor, the rate of growth decreasing from birth to maturity. By rate of growth is meant the increase of the proteid tissues, expressed as a percentage of the amount already present in the animal. Otherwise expressed, the gain of lean meat in a unit of time becomes constantly a smaller and smaller percentage of the amount of lean meat already present in the carcass, or, in general, of the live weight. The accompanying diagram, representing the approximate average results regarding the rate of growth on a considerable number of domestic animals, shows clearly that the rate is high in youth and decreases, at first rapidly and then more slowly, as the animal matures. It should be noted, of course, that the results expressed by the diagram are relative to the weight of the animal and do not show the actual number of pounds of increase per day.

Growth, then, is a function of the immature animal. It appears to take place at a rate fixed by the species and individuality of the animal, and so far as appears cannot be materially stimulated, if at all, by a large supply of proteids in the food, although it can be checked by a deficiency of them because of lack of material. Fattening, on the other hand, is largely dependent on the total amount of food consumed in excess of that required for maintenance. It may take place at any age, provided the food supply is sufficient, but is brought about more easily in fairly mature animals, partly because less of the food is demanded for growth and partly, perhaps, because the older animals consume less in muscular activity.

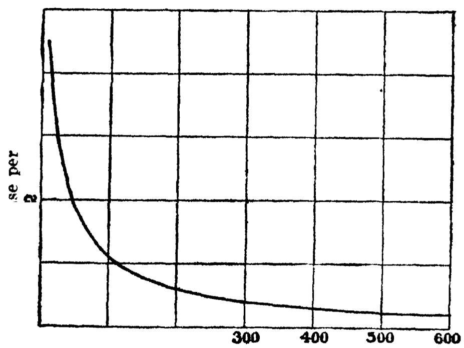


Fig. 69. Rate of increase of proteid tissue per 1,000 pounds live weight at different ages.

Composition of increase in live weight.—It is evident, then, that the composition of the increase in live weight of an animal will contain relatively more proteids and consequently more water (since the water is associated with the proteids) and less fat in a young animal than in an older animal, and also that on a fattening ration the increase of an animal at any given age will contain more fat and relatively less proteids than that of an animal on simply a growing ration. The following table shows the average results of a number of determinations and may serve to illustrate the statement just made:

Composition of Increase in Live Weight

	Average age	Water	Ash	Proteids	Fat	Energy per pound
		Per cent	Per cent	Per cent	Per cent	Calories
Cattle	15	61.99	3.49	18.51	16.01	1,169
	840	39.65	6.18	13.57	40.60	2,100
	1,460*	24.60	1.47	7.69	66.20	3,052
Sheep— On growing ration	290	43.84		11.31	44.85	2,225
	521	27.27		7.03	65.70	3,014
	745	22.18		5.72	72.10	3,255
On fattening ration	290	38.41		9.91	51.68	2,484
	458	16.03		4.13	79.84	3,547
	548*	20.10	2.34	7.13	70.40	3,218
	1,000	12.24		3.16	84.60	3,727
Swine	8	79.48	1.02	17.87	1.63	533
	181	40.37	2.99	9.41	47.23	2,279
	495	47.47	3.40	10.11	39.02	1,943
		22.00	0.06	6.44	71.50	3,247

*Approximate

Influence of age of animal on meat production.—From the above facts, it is clear that age is a very important factor in meat production. It is a familiar fact that animals gain most rapidly when young, and the above table reveals the cause. In the first place, they store up relatively large amounts of proteids as compared with older animals, and in the second place, the proteids thus stored carry a large amount of water with them, which, of course, adds to the weight of the animal. A further consequence of these facts is that gain is made more cheaply by the young animal. A glance at the foregoing table shows, for example, that a pound of gain by tolerably mature cattle contains stored up in it nearly twice as much energy as a similar gain made by young calves. Since this energy is derived from the food of the animal, it is clear that it must require much larger amounts of feed to produce a pound of gain in the second case than in the first. On the other hand, as already noted, fattening does not take place so readily in the young as in the mature animal. Fattening, however, is a more rapid process than growth. In the early stages of the animal's life, then, we shall naturally direct our efforts largely to the production of growth, while the fattening process may begin after the rate of growth has slackened considerably, yet early enough so that when the normal limit of growth of the animal is reached the fattening process

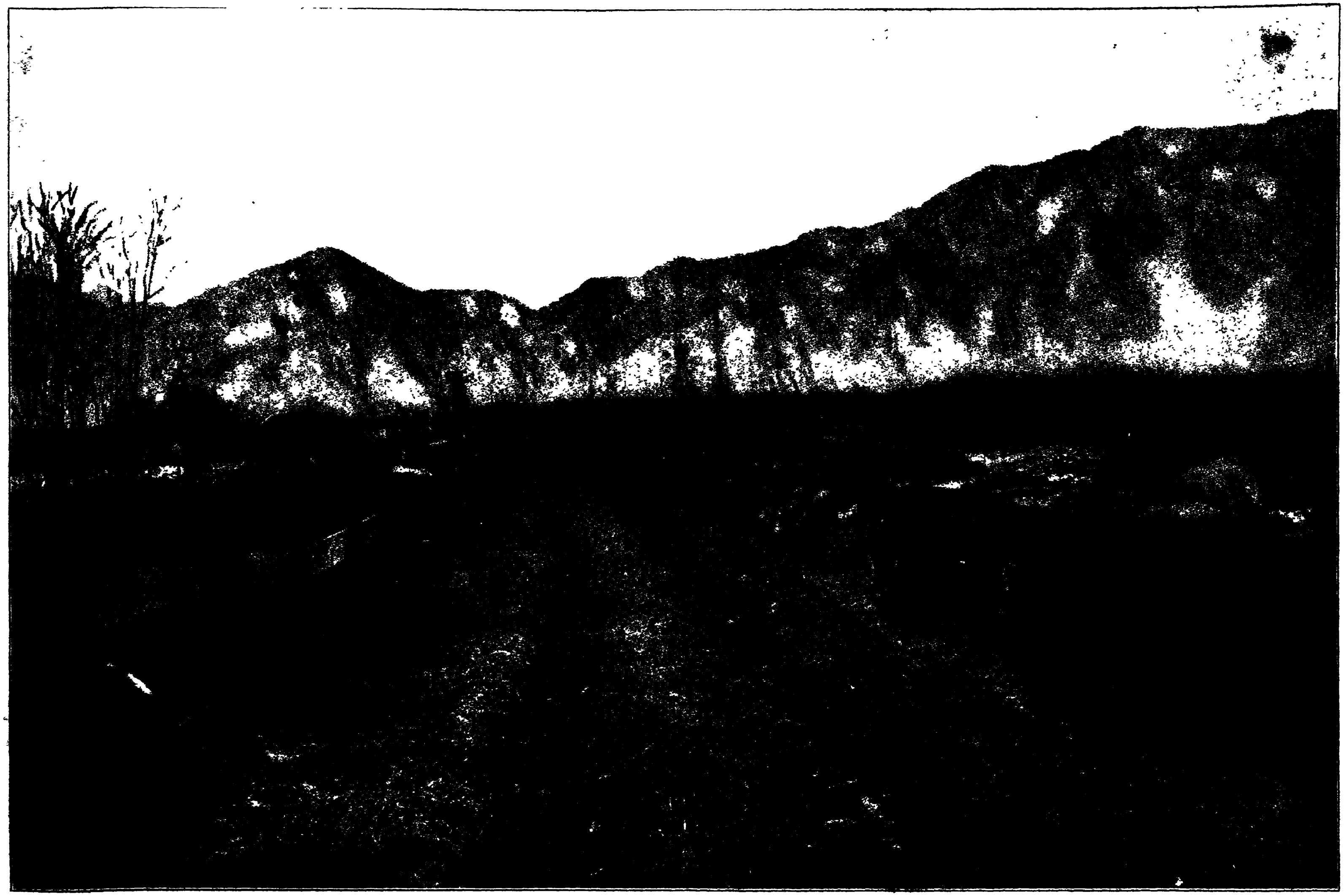


Plate III. Cattle-feeding scene in the Far West

will also be completed, and the animal be ready for sale.

Individuality.—It is a familiar observation that individual animals differ as to their rate of growth. A tendency to early maturity, which is in fact synonymous with rapid growth, is a distinct advantage to the meat-producer in that it tends to shorten the time during which the animal must be fed, and thus to reduce the expenditure for mere maintenance and secure quicker returns for the investment. Animals also differ in their feeding capacity, that is, in the returns made for the feed. This difference is often ascribed to difference in digestive or assimilative power, but at present there is no good evidence of any very marked differences between animals in this respect. It seems probable that the observed differences in feeding capacity may be traced largely to differences in the ability to consume large amounts of feed and perhaps to differences in the maintenance requirement. Anything which increases the former or diminishes the latter would render a larger proportion of the food available for productive purposes, and thus increase the returns from the total feed. This is a point, however, on which further investigation is much needed.

Food requirements.—(1) Proteids.—The proteid requirements for meat-producing animals evidently must be relatively greater in youth and decrease with advancing maturity, while in fully mature animals they are comparatively small. The proteid requirements of mature fattening animals have been greatly exaggerated in the past. Abundant evidence is at hand to show that a proteid supply scarcely greater than that required for maintenance will suffice for the mature fattening animal, although at some sacrifice as regards the percentage digestibility of its food. In the United States, however, most commercial fattening is done with more or less immature animals, and numerous experiments have clearly shown the advantage of a somewhat more liberal supply of proteids than is afforded by many of the rations in common use.

From the results of a considerable number of fattening experiments with cattle, the writer has formulated the approximate proteid requirements shown in the following table, where they are compared with those for growth formulated by Kellner, the leading German authority:

Approximate Proteid Requirements of Cattle, Per 1,000 Pounds Live Weight

American results		German results	
Age 1 month	4.80 lbs.		
Age 2 months	4.00 lbs.	Age 2–3 months	4.50 lbs.
Age 3 months	3.50 lbs.	Age 3–6 months	3.50 lbs.
		Age 6–12 months	2.80 lbs.
Age 1–1½ years	2.00 lbs.	Age 1–1½ years	2.20 lbs.
		Age 1½–2 years	1.50 lbs.
Age 2 years	1.75 lbs.		
Age 2½ years	1.50 lbs.		
		Mature, fattening	1.60 lbs.

Few, if any, American data regarding the proteid requirements of sheep are at present available. Kellner recommends the following amounts at the ages named:

Proteid Requirements for Sheep, Per 1,000 Pounds Live Weight.—Kellner

	Wool breeds	Mutton breeds
Age 5– 6 months	3.0 lbs.	4.5 lbs.
Age 6– 8 months	2.5 lbs.	3.5 lbs.
Age 8–11 months	1.8 lbs.	2.5 lbs.
Age 11–15 months	1.5 lbs.	2.0 lbs.
Age 15–20 months	1.2 lbs.	1.5 lbs.

Pigs are distinguished by a remarkably rapid growth and therefore need a relatively large supply of proteids in the food. Numerous well-known experiments have shown that a deficiency of proteids in the food of the young pig produces disastrous results, leading to a deficiency in the development of the bony and muscular system and an overloading of the carcass with fat. As a natural result there is a tendency to set high proteid standards for the pig—perhaps needlessly high. Kellner's standards for growing pigs are as follows:

Proteid Requirements of Swine, Per 1,000 Pounds Live Weight.—Kellner

	Breeding animals	Fattening animals
Age 2– 3 months	6.2 lbs.	6.2 lbs.
Age 3– 5 months	4.0 lbs.	4.5 lbs.
Age 5– 6 months	3.0 lbs.	3.5 lbs.
Age 6– 8 months	2.3 lbs.	3.0 lbs.
Age 9–12 months	1.7 lbs.	2.4 lbs.

No systematic compilation of American results on this point is at present available, but there is not lacking a number of experiments indicating that considerably lower amounts of proteids for pigs two to six months old may give equally satisfactory results.

(2) Energy.—The total amount of food to be supplied to a meat-producing animal must necessarily remain largely a matter for the skill and experience of the feeder in adapting his feeding to the individuality of the animal. Nevertheless, certain general principles may be indicated.

First, the maintenance requirement of the animal must be satisfied before any gain can be produced. The more feed an animal can be induced to consume in excess of its maintenance ration, the more rapid will be the gain, and the more cheaply it will be produced, because the smaller will be the proportion of the total ration which must be applied to maintenance purposes. For example, if a ration has a production value of 9,000 Cals., and 6,000 Cals. are required for maintenance, only one-third of the ration is applicable to the production of gain. If the gain on this ration is one pound per day, it

takes a total of 9,000 Cals. to produce it. If now the ration be increased to 12,000 Cals. production value, one-half the ration is applicable to production purposes, the gain, other things being equal, will be two pounds per day instead of one, and the total food-cost of a pound of gain will be 6,000 Cals. instead of 9,000 Cals.

Second, rapid gains, especially in fattening animals, can be produced only by the use of concentrated feeding-stuffs. In the first place, as has been shown, the production values of concentrates are higher than those of coarse feeds, although by no means always cheaper per unit. It is only by the use of concentrates, however, that it is possible for the animal to consume the large amount of food required to produce rapid gains. The advantage of being able to give a large amount of food in excess of the maintenance requirement offsets the usually greater relative cost of the concentrated feeding-stuffs.

(3) Feeding standards in the ordinary sense would seem to have comparatively little application in meat production, but, nevertheless, some general statements regarding the total amount of food may be made. These statements include the amount required for maintenance. For young animals larger amounts are required in proportion to the live weight than for mature animals because of their smaller size, and, therefore, relatively greater surface. For cattle and sheep, amounts of feed varying from the equivalent of 20,000 Cals. of production value per 1,000 pounds live weight for very young animals to half that amount for nearly mature animals are recommended by good authorities. These amounts are computed per 1,000 pounds live weight in proportion to the weight. Since swine subsist largely on concentrated feeding-stuffs, they are able to consume relatively larger amounts of food than cattle and sheep. The current feeding standards call for a production value of about 36,000 Cals. per 1,000 pounds live weight for animals two to three months old, the amount gradually diminishing to approximately 17,000 Cals. at ten to twelve months.

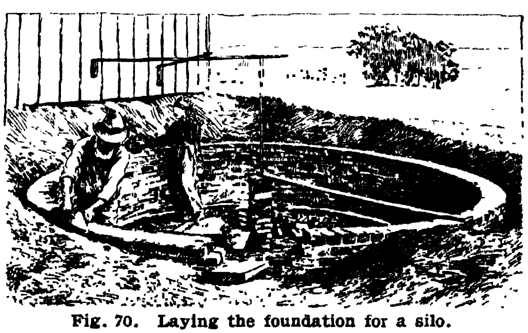


Fig. 70. Laying the foundation for a silo.

Management.—Without entering on a full description of the methods of handling meat-producing animals, the influence of certain factors in their environment calls for consideration.

(1) Exercise.—All forms of muscular exertion are effected ultimately at the expense of food material. In the handling of fattening animals, therefore, which are to be fed for a comparatively short time and where, accordingly, the question of health and vigor is of less importance, it is desirable to reduce the amount of exercise taken as far as practicable. In particular it is important that the surroundings of the animals be made such as to induce them to lie down as large a part of the time as may be, since, as was noted in discussing the maintenance requirement, the mere effort of standing may largely increase the amount of tissue or of food material oxidized, at least by cattle. In the case of growing animals, however, other important considerations come in. Activity of the muscles, as is well known, has a tendency to stimulate their growth, and, since the muscular tissue is the essential part of the meat, the benefits in this respect of moderate exercise may much more than offset the additional amount of food material oxidized. Furthermore, the maintenance of the health and vigor of the animals, particularly in the case of breeding animals, is a consideration which must never be lost sight of.

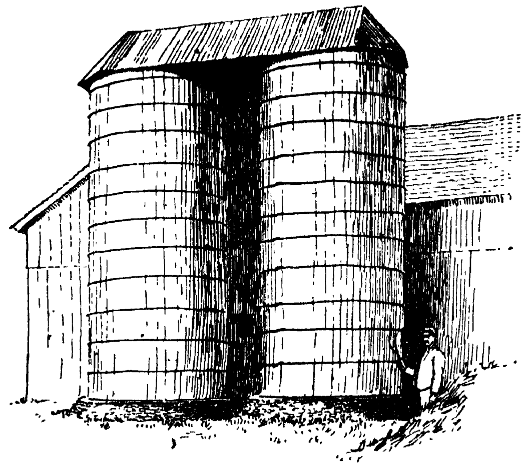


Fig. 71. Modes of feeding. Silos on a dairy-farm.

(2) Temperature.—It was pointed out in discussing the maintenance requirement that except at comparatively low temperatures a simple maintenance ration supplies sufficient heat to maintain the body temperature of domestic animals. With the consumption of heavy growing or fattening rations the amount of heat incidentally liberated in their digestion is greatly increased, and consequently fattening animals may be exposed to a very considerable degree of cold, not only without increasing the use of the food for heat production, but to the very decided advantage of the animals in many cases. Numerous practical feeding experiments have shown that animals, particularly cattle, yield quite as large returns for their food when the feeding is conducted in open sheds or even in feed-lots as when conducted in a warm barn. This is especially true in the comparatively dry winters of the middle and far West. The greater the relative humidity of the air, the more rapidly does it

abstract heat from the animal, as common experience shows. In a moist climate, therefore, animals are more likely to suffer from exposure to cold than in a dry climate, but so far as cattle are concerned the indications are that outside feeding is quite practicable in most if not all parts of the United States.

(3) Shelter.—The question of shelter for meat-producing animals involves much more than the mere matter of temperature. In particular, shelter from precipitation (rain or snow) seems to be a matter of considerable importance When the coat of an animal becomes thoroughly wet, a large amount of heat is required to evaporate the moisture and this may readily overpass the limit beyond which ill effects are produced. This seems to be especially true of sheep as compared with cattle. Furthermore, a dry bed is of importance. In the first place, the heating of wet bedding and especially the melting of snow requires the expenditure of a large amount of animal heat, while, in the second place, comfortable quarters are important, as already noted, in inducing the animal to lie down freely. A shelter is also of some importance as a windbreak. Moving air abstracts heat from the body much more rapidly than still air of the same temperature and humidity.

Fig. 72. Modes of feeding. Bank silo in British Columbia.

(4) Water-supply.—A sufficient water-supply is important for all classes of animals. With our domestic animals the normal consumption is three to four times that of the dry matter of the food. When practicable, the water-supply should be always accessible. The temperature of the water for fattening animals is probably rather unimportant, since, as has been seen, such animals are usually producing an excess of heat. It is not impossible, however, that the drinking at one time of much very cold water may temporarily require an increased production of heat to warm it promptly to the temperature of the body. For this reason, as well as in order to give opportunity to the animals to consume all the water needed, a water-supply accessible at all times is very desirable.

Milk production.

Since but little milk is produced in the United States except by cows, the following discussion will be confined to the feeding of these animals.

Milk production differs very essentially from meat production. In the latter we desire to secure an increase in the size and weight of the animal, and, broadly speaking, all the food supplied in excess of the maintenance requirement aids in producing the desired result. In milk production, on the contrary, what we desire is the product of a single gland of the body. An increase in the weight of the mature animal is not desired; it is at best a diversion of the food to a use other than that intended, while any considerable fattening of the animal has a tendency to check the milk production. Feeding for milk then is not simply a question of supplying certain quantities of proteids and of energy in the feed in excess of maintenance, but also of the distribution which the animal makes of these amounts. The art of milk production consists in stimulating the milk glands to the largest profitable production, and in supplying in the feed the necessary material for this purpose, while avoiding any considerable production of body tissue. Three factors may be said to determine milk production, namely, the animal, its environment, and its feeding.

The animal.—The characteristics of the individual animal, including both the characteristics common to the breed to which it belongs and its own individual peculiarities, may be said in brief to determine the capacity of the animal as a milk-producer. While the actual amount of milk yielded is affected by feed, care and the like, these influences simply determine whether or not the animal shall reach her maximum capacity of production. This capacity might be compared with the limit of speed of a horse. Conditions determine whether it reaches or falls short of its maximum ability. These individual differences are a familiar fact, although their importance is not always fully realized. On the capacity of the cow more than on any other single factor does the dairyman's success depend. Capacity as a milk-producer has been found by experience to be usually associated with certain characteristics of appearance and conformation which differentiate the "dairy type" of cattle from the "beef type." Individuals of the dairy type are most frequent among animals of the recognized dairy breeds, but technical purity of breeding by no means ensures a high degree of excellence as a milk-producer, for individuals of the same breed differ widely in their capacity.

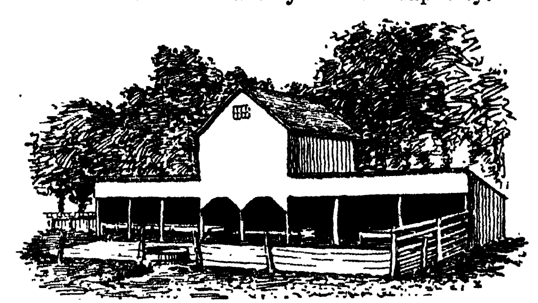


Fig. 73. Brick-paved feed-lot, with convenient shelter, water and feeding arrangement. Adapted from Circular No. 98, Illinois Agricultural Experiment Station.

As regards the composition of the milk, too, the individuality of the animal is practically the determining factor. While minor effects on the composition have sometimes been produced by changes in feeding, they are relatively small and of little or no economic importance. For practical purposes, the composition of the milk is fixed by the inherited breed and individual peculiarities of the animal. This statement applies to the average composition of the milk. It is a well-known fact that the composition may differ from day to day or from milking to milking, especially as regards the percentage of fat. Some animals show very marked differences of this sort, while in others they are much less ; on the average of several days or a week they almost entirely disappear.

The stage of lactation is another factor in the animal which, as is well known, affects the yield of milk. A slight increase in the quantity is frequently noticed in the first month or so after calving. Following that, the typical course is a slow falling off for several months followed by a rapid decrease as parturition is approached. Many irregularities occur, however, varying from animal to animal and from year to year with the same animal. The composition of the milk is also affected, the percentage of solid matter and especially of fat tending to increase with advancing lactation, but these changes are also irregular and vary in different animals.

Environment and care.—The surroundings and care of the animal may also affect the milk yield.

(1) Milking.—The greater the frequency of milking, up to a certain limit, the more and richer milk has been found to be produced, at least in certain rather short experiments, although it may perhaps be doubted whether the difference would be very marked over a considerable period of time. On the other hand, incomplete milking, allowing residues of milk to remain in the udder, tends to depress the activity of milk secretion. It is important, therefore, that cows should be milked frequently enough to prevent this. Beyond this point it simply becomes a question whether the extra milk secured by more frequent milking is sufficient to pay for the additional labor involved. Various methods of manipulating the udder after milking, such, e. g., as the Hegelund method, have been found of practical advantage in increasing the yield of milk and especially of milk-fat. It seems probable that part at least of their good effect is due to the more complete removal of the last residues of milk from the udder.

(2) Exercise.—Since muscular work increases the expenditure of food material, there has been a tendency to deprive dairy animals of a due opportunity for exercise. Direct experiments have shown that a moderate amount of work may be performed by well-fed cows with but a slight decrease in the actual yield of the valuable substances of milk, although the amount of water in the milk was somewhat lessened. On lighter rations, work tends to draw on the body fat, but the amount of energy expended in this way is probably slight as compared with the beneficial effects on the health and general condition of the animals of daily opportunity for freedom, motion and fresh air.

(3) Temperature. A dairy cow is probably, like a beef steer, producing more heat in her body than is needed to keep her warm under ordinary conditions. Exposure to moderate cold, therefore, does

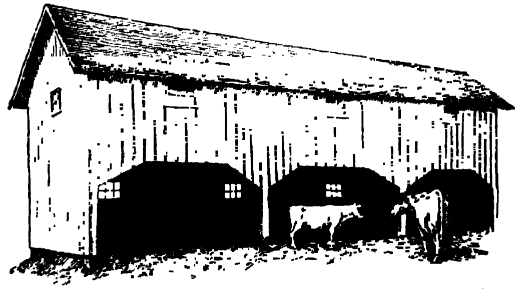


Fig. 74. Modes of feeding. Cow-shed in feed-yard

not necessarily result in increasing the amount of material burned up in the body. It must be borne in mind, however, that a typical dairy cow probably exposes more surface to radiation than a beef steer of the same weight, and that she usually lacks the protective layer of fat. She is, therefore, probably unable to withstand as low temperatures as the steer without extra consumption of food for warmth. But above a certain degree, what is true of the steer will also be true of the cow.

This is not equivalent, however, to saying that exposure to cold will have no effect on the milk yield. The danger is that a sudden chill, through nervous influence, will check the activity of the udder and turn the current of nutrition away from milk production to fat production. Accordingly, it is advisable to prevent abrupt changes of temperature or exposure to cold draughts. On the other hand, certain experimenters have been successful in keeping dairy cows through the winter in a cold but dry, covered barnyard, the animals having been accustomed to this treatment gradually during the fall. The question is of more importance, however, as regards stable ventilation. It seems probable that rather lower temperatures than have hitherto been considered advisable may be admissible in a dairy-barn, and that, consequently, better ventilation may be practicable without the necessity for artificial heating.

(4) Water-supply.—An abundant supply of pure water is even more essential to dairy cows than to other classes of stock. Not only do they consume a large amount of dry matter, requiring, as already stated, about four times its weight of water, but about 87 per cent of the milk produced is also water. The water-supply not only should be abundant, but also should be accessible to the cows as frequently as practicable. From this point of view, the various self-watering devices constitute an ideal method of watering. Comparisons have shown that when water is constantly accessible cows may consume sensibly more than when they are watered but once or twice a day, and that the larger consumption of water may result in an increased production of milk without any falling off in the

quality. If self-watering devices are not too expensive, and can be kept clean, they are to be recommended, especially for dairy cattle.

Much has been written regarding the proper temperature of the water-supply. In the light of the preceding paragraph, it would appear that simply from the point of view of heat saving there is little if any occasion for heating the water-supply. Numerous tests have shown increased production of milk as a result of warming the drinking water, but it is probable that much of this effect at least arises from the fact that very cold water is not consumed in sufficient quantity to supply the needs of the animal. To this extent, warming the supply is advisable.

(5) Handling.—The secretion of milk is to a greater or less degree under the control of the nervous system of the animal. Any abuse of the animal or undue excitement is likely to diminish the milk-production, and the same thing is true of discomfort from any source. Dairy cows should be kept as quiet and comfortable as practicable, and consideration and humanity in their handling have a distinct monetary value.

Feeding.—As regards the feeding of the dairy cow, we need to consider both the proteid supply and the energy supply.

(1) Proteids.—Milk is decidedly proteid in its composition. If the carbohydrates (milk-sugar) of the milk be reduced to their equivalent of fat by dividing by 2.25, the ratio of proteids to fat and its equivalent in average milk is approximately one to two. This is a much larger proportion of proteids than is contained in the gain in body weight in any except very young animals. Naturally, therefore, the production of milk calls for a liberal supply of proteids in the food. Wolff's familiar standard calls for 2.5 pounds digestible protein per day for a 1,000-pound cow in full flow of milk. The later Wolff-Lehmann standards have modified this by making the requirement somewhat in proportion to the milk yield. American investigations in recent years seem to indicate that the amounts called for in the German standards may be unnecessarily large.

The dairy cow requires proteids for two purposes, first, for the maintenance of her body tissues and, second, as a source of supply of the proteids of the milk. Thus, a 1,000-pound cow would require, as we have seen, about .5 pounds of digestible proteids for maintenance. If she is producing twenty pounds per day of milk, of average composition, that milk will contain .64 pounds of proteids. The cow, therefore, will require in her daily ration at least 1.14 pounds of digestible proteids for these two purposes together. Experience, shows, however, that a certain excess over this minimum is necessary. In the first place, it is doubtful whether the food proteids can be converted into milk proteids without some loss in the process. In the second place, a certain excess of proteids seems to be necessary to maintain, or at least to stimulate, the activities of the udder, by which milk is produced. How large an excess is necessary for this purpose, however, is still to a degree an unsettled question. German authorities recommend an excess of 50 to 100 per cent over the proteids of the milk, according to the extent to which the cow is being pushed. This would make the total proteid requirement in the case supposed 1.78 pounds. There are not wanting, however, experiments which seem to indicate that so large an excess is unnecessary and that possibly an excess of not more than 25 to 35 per cent may be sufficient. Twenty-five per cent excess would make the requirement in the above case 1.30 pounds. Of the above results, then, even the highest, it will be observed, is less than the old Wolff standard. One reason for this, however, is that they refer to true proteids and not to the total protein of the ration. The question of the proteid supply is, in part, an economic question. As the proteids in the ration are increased, while they probably stimulate the milk production, an increasing proportion of them is simply metabolized in the body and goes to enrich the excreta. Consequently, the stimulation of the milk production is secured at a relatively increasing price, and, ultimately, must reach an economic limit.

(2) Energy.—The solids contained in one pound of average milk correspond to about 340 Cals. of energy. This amount varies, of course, with the composition of the milk, being greater the larger the percentage of total solids and especially of fat, so that, for example, one pound of fairly good Jersey or Guernsey milk would be equivalent to about 390 Cals. For the present purpose, however, it seems preferable to base comparisons on milk of average composition. To produce one pound of such milk it is evident that the cow must be supplied, in addition to her maintenance requirement, with food having a production value of 340 Cals. Unfortunately no direct determinations of the production values of feeding-stuffs for milk have yet been reported. Kellner, however, adduces reasons for believing that the values for meat production as tabulated on a previous page are approximately applicable also to milk production, and confirms this conclusion by examples drawn from practice. If this belief is justified, it becomes a comparatively easy matter to compute the food requirements of a dairy cow. If, for example, we have a cow weighing 1,000 pounds and producing 22 pounds of average milk daily, her daily ration must contain $340 \times 22 = 7{,}480$ Cals. of production value in addition to her maintenance requirement. As we have already seen, the maintenance requirement of such an animal is approximately 7,350 Cals. of net available energy, of which not over 70 per cent—equal to about 5,150 Cals.—would be production value. On this basis, then, the requirement of the animal in terms of production values will be:

For milk production	7,480 Cals.
For maintenance	5,150 Cals.
Total	12,630 Cals.

A study of experiments on milk production, however, shows that the ratio between food and milk is by no means constant. The tendency to milk

production is such that the activity of the glands will continue for a long time even on an insufficient ration, the lacking material being drawn from the tissues of the body. In such a case the apparent food requirement obviously will be below the truth. On the other hand, heavy feeding, while tending to increase the milk production, also tends to cause a gain of tissue, especially of fat, by the animal, and in this case the apparent food requirement is larger than the true one. Between these two extremes experiments indicate that the amount of food which must be supplied for the production of a pound of milk after the maintenance requirement is satisfied is approximately uniform, and that if not exactly measured by Kellner's production values it is at least fairly proportional to them. If this be true, it is clear that the more liberal the feeding can be made without causing the animal to fatten (that is, the greater the capacity of the cow as a milk-producing machine) the larger will be the return per unit of total food, precisely as explained in the case of the fattening steer, since the proportion of the ration used for productive purposes becomes greater. In practice, however, we have to reckon with the fact that on a liberal ration there is an increasing tendency for the animal to get fat, and that when cows are pushed to their capacity a considerable proportion of the food is liable to be applied in this way, this proportion increasing as the limit of milk production is approached. Consequently, on heavy feeding, the milk production becomes more and more expensive, and a limit is soon reached beyond which it is not economically profitable to force the cow.

(3) Fat requirements. — Comparatively recent experiments seem to show that for a dairy ration to reach its maximum efficiency it must contain a certain minimum amount of digestible fat. While it has been demonstrated that milk-fat can be and is produced from other ingredients of the food than fat, nevertheless, a diminution of the fat below .75 to 1.0 pounds per day seems to affect unfavorably the production of milk and especially of milk-fat. This fact should be borne in mind in the computation of rations, although as a rule American rations tend to be high rather than low in fat.

(4) Choice of feeding-stuffs. —The proportion of coarse fodder in a dairy ration may vary within wide limits according to the intensity of the feeding and the capacity of the digestive organs. The total dry matter of a ration may range from twenty to thirty pounds, the smaller amount, of course, indicating a less percentage of coarse fodder. When the cow is to be pushed to her full capacity, it will be necessary to increase the proportion of concentrated feeding-stuffs, while in moderate feeding coarse fodder may form a considerable proportion of the ration, especially if palatable and of good quality.

Practice shows that a supply of succulent food is an important factor in the welfare of a dairy herd. A part of its advantage doubtless arises from the less amount of energy which has to be expended in its mastication, digestion and assimilation, but it may be questioned whether this factor plays a very large part. It seems more probable that the chief advantage of succulent food arises from its dietetic effect; that it tends to stimulate milk production rather than fattening. The various root crops, including such residues as sugar-beet pulp, are recognized as the most desirable kind of succulent food, but their use is rather limited, owing to the expense of growing and handling them. In American practice, silage, especially of corn, is more widely used for succulent food.

Finally, the effect of the ration on the taste and odor of the milk is an important element in the choice of feeding-stuffs for the dairy cow. Certain materials, as turnips, cabbage, rape, garlic, wild mustard and the like, transmit their peculiar flavors directly to the milk, with more or less readiness, while other feeding-stuffs seem to affect the milk indirectly through the air of the stable rather than directly through the organism. The longer the time elapsing between the feeding of one of these materials and the milking the less is likely to be the injurious effect. Consequently these effects can often be prevented or moderated by giving the feeding-stuff in question immediately after milking.

Feeding for work production.

The horse (or mule) is almost the exclusive working animal in the United States, and the following discussion will be confined to this animal.

Source of energy. — Work is performed by an animal by the contraction of its muscles, and the energy required is furnished by the breaking down of materials contained in them. Since the muscles are largely proteid in their nature, it was for a long time thought that in the performance of work this proteid material was broken down and oxidized. Exact experiments, however, have demonstrated that this is not necessarily the case. It has been found that when the animal is receiving an adequate amount of total food, the breaking down of proteids in the body is not increased by the performance of work. On the other hand, muscular exertion causes a very marked increase in the amount of non-nitrogenous matter metabolized. In the contraction of a muscle there appears to be a sudden breaking down of some non-nitrogenous material in the muscle, a part of the energy liberated appearing as heat and another part as mechanical work. The products resulting from this chemical action are subsequently burned up by means of the oxygen carried to them by the blood, so that the net result is an increased consumption of oxygen and an increased evolution of carbon dioxid and water by the animal. Under normal conditions, then, the energy expended in work is derived from the breaking down and oxidation of non-nitrogenous materials. If, however, the supply of these in the food is not sufficient to make good the amount oxidized, a part of the proteids of the food or the body may also serve as a source of muscular energy. In brief, then, all the ingredients of the food may serve as sources of power, but normally the latter is derived chiefly from the carbohydrates and fats.

Certain secondary effects of muscular exertion must also be taken into account. In order to supply the muscles with the necessary oxygen to act

on the products of the breaking down of matter, and also to carry away the carbon dioxid resulting from the oxidation, the rapidity of the circulation of the blood must be increased, and in order to purify the blood in the lungs the respiration must also be quickened and deepened. All this involves work on the part of the muscles of the heart and respiratory organs, and this work, like the external work, is at the expense of material contained in those muscles, and has to be provided for in the food as well as the expenditure by the muscles directly concerned in the performance of the external work.

Available energy.—The ultimate source of energy for muscular work is, of course, the food consumed by the animal, and chiefly, as has been seen, its carbohydrates and fats. It is important, however, to remember that the immediate source of muscular energy is the breaking down of material in the tissues. A fasting animal can perform work for a certain length of time. The function of the food is to replace the loss of tissue caused by the muscular activity. For this purpose, only that part of the energy of the food is available which is left after the necessary expenditure for the digestion and assimilation of the food. In other words, it would appear that the food is of value for the production of work in proportion to its net available energy, or maintenance value. On a preceding page there has been given a table showing the results secured by Zuntz and Hagemann, for the available energy of certain feeding-stuffs for the horse. Assuming these figures to be correct, they show, for example, that one pound of meadow hay will supply sufficient energy to the body of the horse to make good an expenditure by the muscles of 327 Cals. of energy for the performance of muscular work, while one pound of oats would make good a loss of 882 Cals. Unfortunately, however, the data on which this table is constucted involve a number of assumptions and the results are of somewhat questionable value.

Utilization of available energy.—Very extensive and careful experiments have been made to determine how much of the energy liberated in the body by the breaking down and oxidation of tissue during muscular work is actually recovered in the form of work. The general method of these experiments has been to determine the increased amount of oxygen taken up and carbon dioxid given off during work. From these results, it is easily possible to determine the amounts of carbohydrates and fats metabolized in the body, and from these the amount of energy liberated. This latter amount is then compared with the actual amount of work done.

(1) Locomotion.—In doing work, the horse has first of all to move his own body, and this requires a certain expenditure of energy. In addition to this he may draw a load, or carry it on his back, either on a level or uphill, thus doing useful work and requiring an additional expenditure of energy. For moving his own body a distance of one mile along a level surface, it has been found that a horse weighing 500 kilograms (1,100 pounds) oxidizes carbohydrates and fats equivalent to the following amounts of energy:

Walking—	
Speed of 2.88 miles per hour . . .	264 Cals.
Speed of 3.33 miles per hour . . .	298 Cals.
Speed of 3.62 miles per hour . . .	319 Cals.
Trotting	445 Cals.

It appears that the exertion required to walk a given distance on level ground increases as the speed increases. When the gait is changed to a trot there is a marked increase in the energy expended in traveling the same distance, but the requirement remained unaffected by the speed up to a rate of about 7.5 miles per hour, beyond which no experiments were made. It may be safely assumed, however, that at high speeds the expenditure of energy is much greater. There is no way of directly measuring the actual amount of mechanical work performed in simple locomotion, so as to compare it with the amount of energy liberated in the body. The best available computations of it, however, indicate a percentage utilization of the energy in this form of work of about 35 per cent, or rather greater than that observed in most forms of useful work; but no very great accuracy can be claimed for the result.

(2) Useful work.—The useful work of a horse or other prime motor is commonly measured in foot-pounds, one foot-pound being the energy required to lift one pound one foot vertically. One Calorie of heat energy is equivalent to 3,087 foot-pounds. If, now, we require a horse to do 3,087 foot-

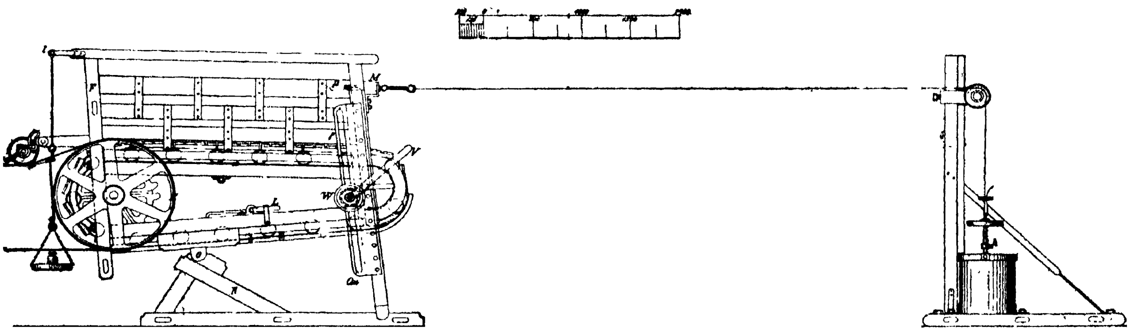


Fig. 75. Sketch of the Zuntz tread-power dynamometer. (Adapted from Landw. Jahrb., Vol xviii, Plate I.)

pounds of useful work, we find that the amount of energy which he expends, in addition to that required for moving his own body horizontally, will be about three Calories; in other words, about one-third of the energy liberated is recovered in the work done. The proportion utilized varies, however, with different kinds of work, as the following table shows:

PERCENTAGE UTILIZATION OF NET AVAILABLE ENERGY BY THE HORSE

	Per cent
Walking—	
Ascending 11 per cent grade	34.3
Ascending 18 per cent grade	33.7
Ascending 16 per cent grade with load on back	36.2
Draft 0.5 per cent grade	31.3
Draft 8.5 per cent grade	22.7
Trotting—	
Ascending 11 per cent grade	31.96
Draft 0.5 per cent grade	31.7

It is seen that, in general, about one-third of the energy actually liberated in the body is recovered in the form of work, the remaining two-thirds taking the form of heat and causing the familiar increase in heat production during work. It will be observed, however, that the percentage of the energy recovered varies more or less, it being affected by the kind of work, by the speed of the animal, by the gait (whether trotting or walking), and other factors. The individuality of the animal also plays a part, horses of one type showing a greater efficiency as riding horses and others a greater efficiency as draft horses.

The foregoing results are often cited to show the high efficiency of the animal as a prime motor in comparison with artificial motors. Such a comparison, however, is to a certain degree misleading. It fails to take account of the fact that to perform work the animal must expend a considerable amount of energy in moving his own body, and that a further expenditure of energy is required for his maintenance even when doing no work. Moreover, it ignores the expenditure of energy required to digest the food and prepare it for use in the organism. When all these factors are included, but little remains of the supposed superiority of the animal over the artificial motor.

Energy requirements of the horse.—The foregoing data afford a basis for computing the expenditure of energy by the horse in the performance of a known amount and kind of work.

For example, suppose a horse weighing 1,100 pounds is required to haul a load of one ton 20 miles per day on a level road at the rate of 2.88 miles per hour, the draft averaging 100 pounds. The useful work will then be:

$$5{,}280 \times 20 \times 100 = 10{,}560{,}000 \text{ ft.-lbs.} = 3{,}421 \text{ Cals.}$$

According to the table just given, 31.3 per cent of the energy liberated in the body is utilized in draft. To perform 3,421 Cals. of work, therefore, will require the expenditure of $3{,}421 \div 0.313 = 10{,}929$ Cals. of energy in the body. The expenditure of energy for locomotion, according to a previous table, will be $264 \times 20 = 5{,}280$ Cals. To these must be added the maintenance requirement of the animal as computed by Zuntz and Hagemann, viz., 4,356 Cals. The available energy required per day then will be:

For useful work	10,929 Cals.
For locomotion	5,280 Cals.
For maintenance	4,356 Cals.
Total	20,565

The foregoing computation furnishes an illustration of the statements previously made regarding the efficiency of the animal as a motor. In this instance, the performance of work equivalent to 3,421 Calories requires an expenditure of 20,565 Calories of net available energy. To supply this amount of net available energy to the animal in ordinary feeding-stuffs would require food having a fuel value of approximately 27,500 Calories.

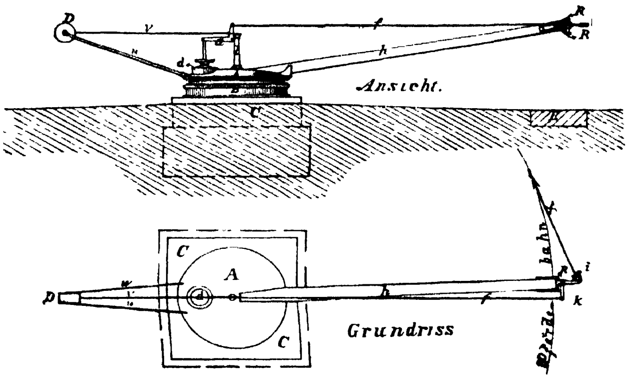


Fig. 76. Sketch of dynamometer used by Wolff. (Adapted from Landw. Versuchs-Stationen, Vol. xxi)

Accordingly, the actual utilization of the fuel value of the food is, in this instance, 12.4 per cent, or less than that of a good steam engine.

If we assume ten pounds of hay and ten pounds of oats as the basis of the ration of the horse in the foregoing example, the remainder of the food to be supplied in the form of corn, we make the following computation (based on the table of available energy already referred to on page 66):

NET AVAILABLE ENERGY

Requirement		20,565 Cals.
Basal ration –		
10 pounds meadow hay	3,270 Cals.	
10 pounds oats	8,820 Cals.	
		12,090 Cals.
Lacking		8,475 Cals.
Corn to complete the ration		
$8{,}475 \div 1{,}263 = 6.72$ pounds.		

So far as concerns the amount of energy actually expended by the working animal, the basis for such computations as the foregoing appears well established. Unfortunately, the same is not true of the data for the available energy of feeding-stuffs for

the horse, as was noted in connection with the table. They do not represent the direct result of experimental work, but are computed from data, some of which appear of questionable validity.

Pending more accurate determinations of the available energy of feeding-stuffs for the horse, Kellner has made the attempt to utilize for this purpose the production values of feeding-stuffs which he has worked out for cattle. The method is admittedly a temporary expedient, but he regards it as more satisfactory than the estimates of available energy on which the foregoing computation was based. He uses as the basis of his method the maintenance requirement as formulated by Wolff, namely, 7.27 pounds fiber-free nutrients per 500 kilograms live weight. Assuming this to be equivalent to an equal weight of starch, it corresponds to a production value of 7,788 Cals. Further, on the basis of the average results of Zuntz and Hagemann, Kellner assumes that one-third of the starch value of feeding-stuffs can be utilized for work, which is equivalent to a utilization of 53 per cent of the production value. The actual work done by the animal, then, divided by .53, with the maintenance requirement added, would give the ration required for any given amount of work. Comparisons of this method of computation with the results of Wolff's extensive experiments show a very fair agreement. Applying Kellner's method to the example previously given, we should have the following results, expressed in terms of production values:

For useful work . . . 3,421÷0.53 =	6,454 Cals.
For locomotion	3,118 Cals.
For maintenance	7,788 Cals.
Total	17,360 Cals.

			Nitrogen-free extract	Fat	Fiber-free nutrients (fat x 2.4)
	Pounds	Pounds	Pounds	Pounds	Pounds
Light work . .	0.99	1.24	5.06	0.32	6.82
Moderate work .	1.49	1.63	8.09	0.42	10.59
Heavy work . .	1.12	1.35	6.94	0.49	9.24

Assuming as before the basis of the ration to be ten pounds of hay and ten pounds of oats, and using Kellner's production values (page 67), we have:

PRODUCTION VALUES

Requirement		17,360 Cals.
Basal ration—		
10 pounds hay . . .	3,356 Cals.	
10 pounds oats . . .	6,628 Cals.	
		9,984 Cals.
Lacking		7,376 Cals.
Corn to complete ration . . . . . 7,376÷888 = 8.30 pounds.		

As will be seen by this example, Kellner's method of computation tends to give somewhat higher results than the one previously employed.

Proteid requirements.—It has already been pointed out that muscular work is performed at the expense of the carbohydrates and fats of the food. Provided, therefore, that the ration of the working animal contains ample proteids to maintain the proteid tissues of the body when at rest, no more need be added because of the work performed. All that is necessary is that the ration shall contain a sufficiently large proportion of protein to insure its full digestibility. It is probable that a nutritive ratio of one to eight or perhaps even wider is ample for all purposes of work production.

Standards.—By either Zuntz's or Kellner's method it is possible to compute a ration corresponding accurately to any given requirement. The practical difficulty is that, as horses are ordinarily used, these requirements are variable and not readily capable of exact measurement. When the work of a horse is fairly uniform from day to day, and particularly if a considerable number are kept, such computations as those indicated may prove of value. In most cases, however, the amount of food must be proportioned to the work done in accordance with the skilled observation and judgment of the feeder. As a general guide, Kellner recommends the following amounts per 1,000 pounds live weight:

	Proteids	Production value
For light work . . .	1.0 lbs.	9,800 Cals.
For medium work . .	1.4 lbs.	12,400 Cals.
For heavy work . .	2.0 lbs.	16,000 Cals.

In an investigation of the practice of horse-feeding in the United States, Langworthy obtained the following average results for the digestible nutrients consumed per 1,000 pounds live weight. The results on heavy work are based on only a few observations on heavy draft horses.

Assuming the fiber-free nutrients to be equivalent to starch, the above figures correspond to the following production values:

Light work	7,302 Cals.
Moderate work.	11,330 Cals.
Heavy work	9,893 Cals.

These figures are considerably lower than those recommended by Kellner and suggest the need for further investigation, although it is to be noted that Langworthy's figures are based on digestive coefficients obtained with the horse, while Kellner uses those obtained in experiments on cattle.

The somewhat limited capacity of the digestive organs of the horse makes it evident that if a large amount of energy is to be supplied it must be contained, to a considerable degree, in concentrated feeding-stuffs, since otherwise it would be impossible for the animal to consume a sufficient weight

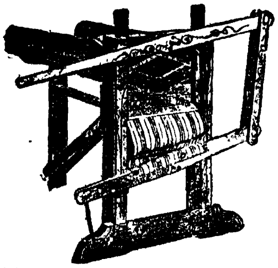


Fig. 77. Lever hay- and straw-cutter.

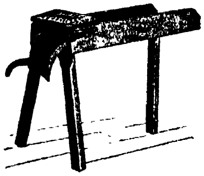


Fig. 78. A lever cutter.

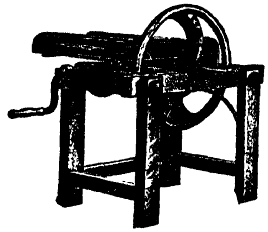


Fig. 79. Hand or power feed-cutter.

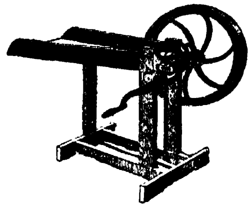


Fig. 80. Self-sharpening feed-cutter.

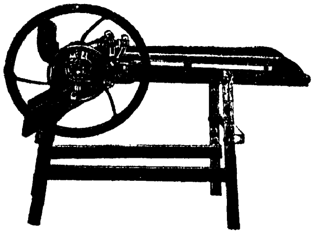


Fig. 81. Speedway power feed-cutter.

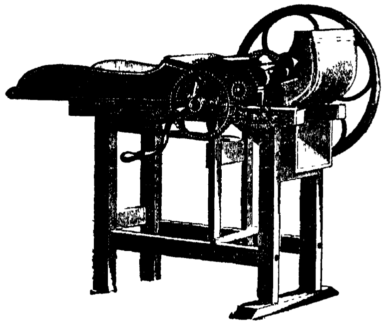


Fig. 82. Hand or powe**ı** cutter.

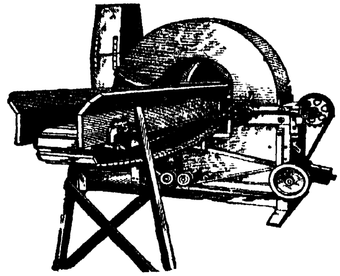


Fig. 83. Safe lion silage-cutter with blower.

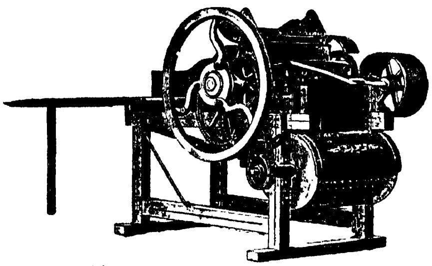


Fig. 84. Cutter and crusher.

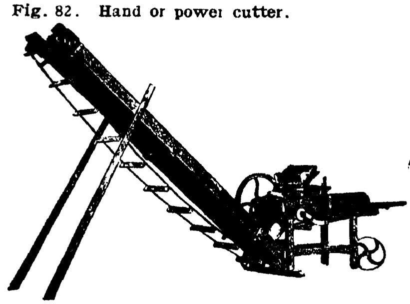


Fig. 85. Silage- and fodder-cutter with reversible carrier.

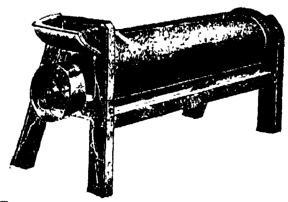


Fig. 86. Cannon corn-sheller.

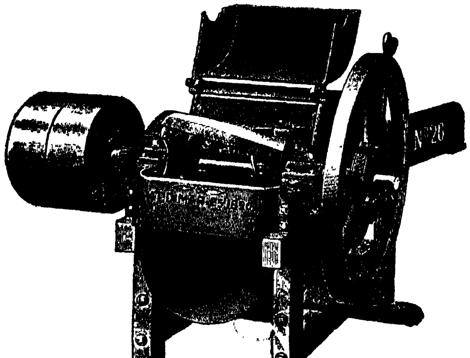


Fig. 87. Silage- and feed-cutter.

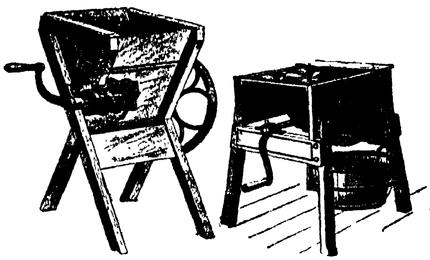


Fig. 88. Other forms of root-cutters.

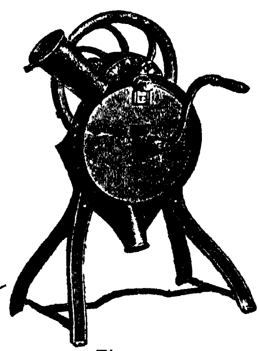


Fig. 89. Iron corn-sheller.

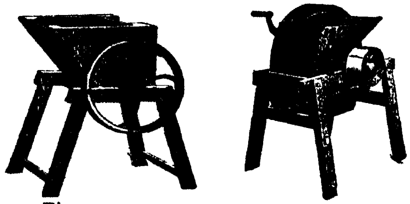


Fig. 90. Two forms of root-cutters.

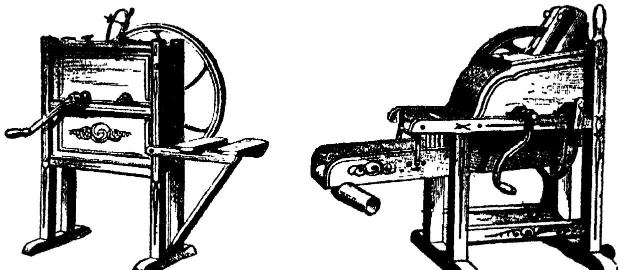


Fig. 91. One-hole corn-shellers. The larger one has a capacity of sixty to eighty bushels per hour; weight, 290 pounds.

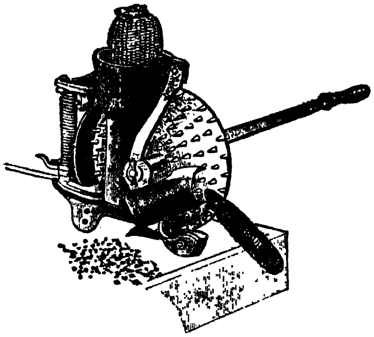
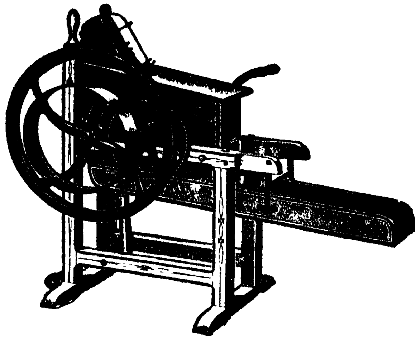


Fig. 92. **A hand corn-sheller.**



F g. 93. Double hopper corn-sheller for hand or power.

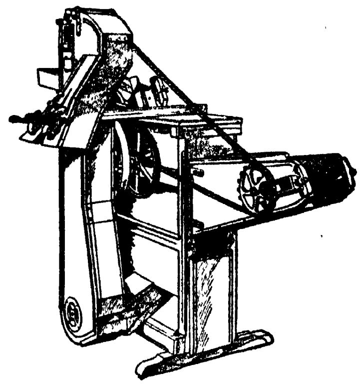


Fig. 94. **Two-hole corn-sheller.**

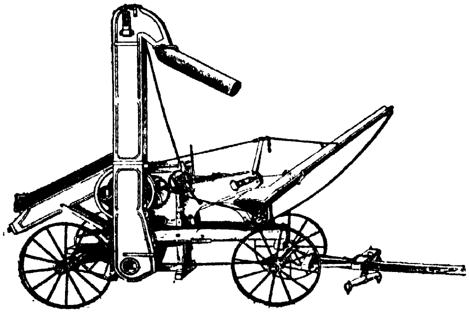


Fig. 95. **Another type of cross corn-sheller.**

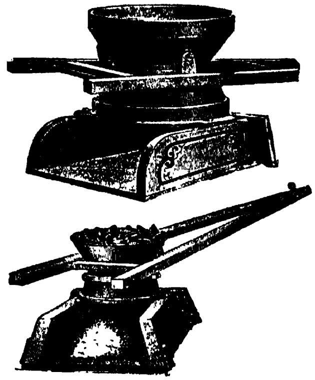


Fig. 96. **Foims of feed-mills and cob-crushers.**

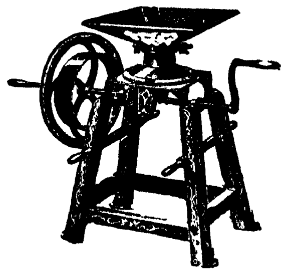


Fig. 97. **Hand and power mill.**

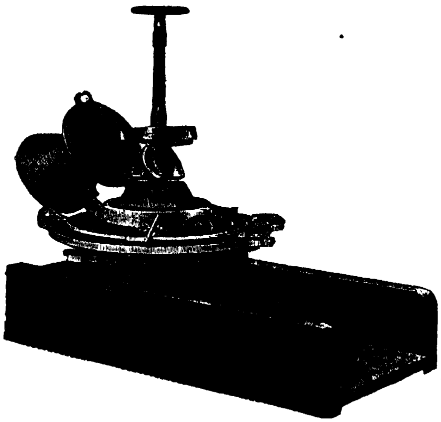


Fig. 98. A sweep mill.

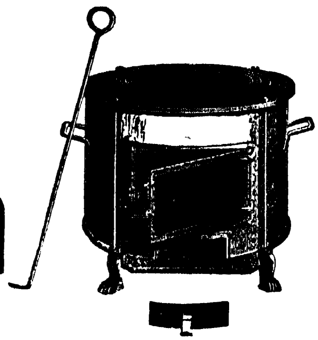


Fig. 99. A kettle ange foi cooking food for animals.

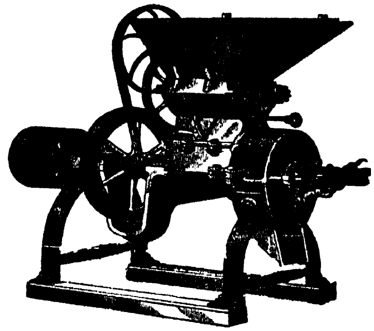


Fig. 100. Duplex grinding mill.

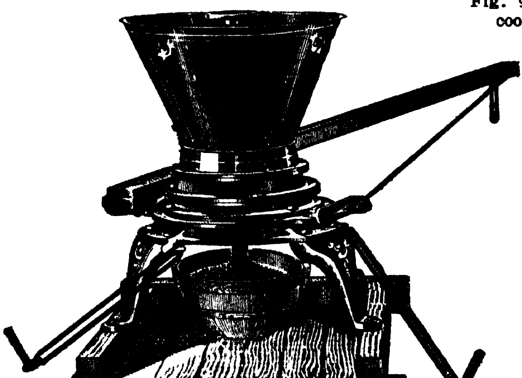


Fig. 101. Grinding mill.

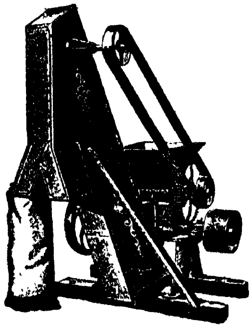


Fig. 102. Sacking feed elevator with deliveries for two sacks.

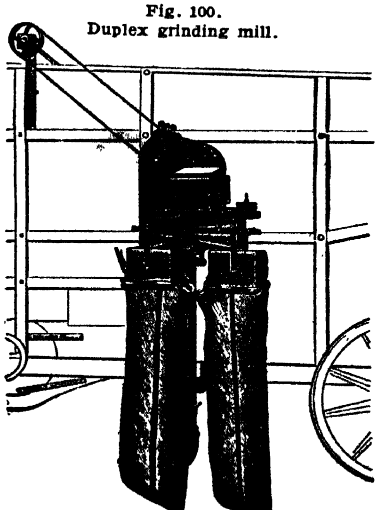


Fig. 103. Grain bagger and weigher.

of food to be equivalent to the work requirement. As the severity of the work increases, the ration should consist, to a larger and larger extent, of grain, with only sufficient coarse fodder to furnish the necessary bulk. Probably the majority of farm horses are fed an excessive amount of hay. This excess not only fails to produce the desired nutritive effect but overloads the digestive organs and tends to interfere with the breathing of the animal.

It should be noted that all the foregoing considerations relate to work horses. While some of them, notably the avoidance of an excess of coarse fodder, apply equally to the race horse or fast roadster, the feeding of such animals is an art by itself. In many cases the total amount of work which they perform is less than that of the ordinary work horse, but they are required always to be in condition for strenuous exertion for a short time. No scientific data are available as to the expenditure of energy or the food requirements at high speed.

Literature.

Armsby, Manual of Cattle Feeding, New York, John Wiley & Sons (1880); Stewart, Feeding Animals, third edition, Lake View, N. Y., The Author (1886); Henry, Feeds and Feeding, second edition, Madison, Wis., The Author (1900); Jordan, The Feeding of Animals, New York, The Macmillan Company (1901); Ware, Cattle Feeding with Sugar Beets, Sugar, Molasses and Sugar Beet Residuum, Philadelphia, The Philadelphia Book Company (1902); Warrington, The Chemistry of the Farm, 15th edition, London, Vinton & Co. (1902); Armsby, Principles of Animal Nutrition, New York, John Wiley & Sons (1903); Shaw, The Feeding and Management of Live Stock, St. Anthony Park, Minn. (1902); Anderson, Influences Affecting Milk Production, Ithaca, N. Y. (1902); Snyder, The Chemistry of Plant and Animal Life, Easton, Pa., The Chemical Publishing Company (1903); Smith, Profitable Stock Feeding, Lincoln, Nebraska, The Author (1906); Shaw, Feeding Farm Animals, New York, Orange Judd Co. (1907).

FEEDING AND COMPUTATION TABLES

Much effort has been expended in compiling tables for the computation of rations for farm animals. For extensive tables the reader is referred to Voorhees, Forage Crops; Jordan, The Feeding of Farm Animals; Roberts, The Fertility of the Land, The Horse, and The Farmer's Business Handbook (3 books); Woll, Handbook for Farmers and Dairymen; Wilcox & Smith, Farmer's Cyclopedia of Agriculture; Smith, Profitable Stock-Feeding; Brooks, Agriculture, Vol. IV, Animal Husbandry; Allen. The Feeding of Farm Animals, Farmer's Bulletin No. 22, United States Department of Agriculture; Bulletin No. 81, Vermont Agricultural Experiment Station. The three tables that follow here are adapted from Henry's "Feeds and Feeding," by the courtesy of Prof. Henry.

TABLE I. AVERAGE COMPOSITION OF AMERICAN FEEDING-STUFFS.

Feeding-stuffs	Percentage composition: Water	Ash	Protein	Crude fiber	Nitrogen free extract	Ether extract	No. of analyses
CONCENTRATES							
Corn, dent	10.6	1.5	10.3	2.2	70.4	5.0	86
Corn, flint	11.3	1	10.5	1.7	70.1	5.0	68
Corn, sweet	8.8	9	11.6	2.8	66.8	8.1	26
Corn meal	15.0	4	9.2	1.9	68.7	3.8	77
Corn cob	10.7	.4	2.4	30.1	54.9	0.5	18
Corn-and-cob meal	15.1	[illegible]	8.5	6.6	64.8	3.5	7
Corn bran	9.1	3	9.0	12.7	62.2	5.8	5
Corn germ	10.7	0	9.8	4.1	64.0	7.4	3
Hominy chops	11.1	2.5	9.8	3.8	61.5	8.3	12
Germ meal	8.1	1.3	11.1	9.9	62.5	7.1	6
Dried starch and sugar feed	10.9	0.9	19.7	4.7	54.8	9.0	4
Starch feed, wet	65.4	0.3	6.1	3.1	22.0	3.1	12
Maize feed (Chicago)	9.1	0.9	22.8	7.6	52.7	6.9	3
Grano-gluten	5.8	2.8	31.1	12.0	33.4	14.9	1
Cream gluten	8.1	0.7	36.1	1.3	39.0	14.8	3
Gluten meal	8.2	0.9	29.3	3.3	46.5	11.8	20
Gluten feed	7.8	1.1	24.0	5.3	51.2	10.6	11
Wheat, all analyses	10.5	1.8	11.9	1.8	71.9	2.1	310
Wheat, spring	10.4	1.9	12.5	1.8	71.2	2.2	13
Wheat, winter	10.5	1.8	11.8	1.8	72.0	2.1	262
Flour, high grade	12.2	0.6	14.9	0.3	70.0	2.0	1
Flour, low grade	12.0	2.0	18.0	0.9	63.3	3.9	1
Flour, dark feeding	9.7	4.3	19.9	3.8	56.2	6.2	1
Bran, all analyses	11.9	5.8	15.4	9.0	53.9	4.0	88

TABLE I. AVERAGE COMPOSITION OF AMERICAN FEEDING-STUFFS, continued

Feeding-stuffs	Percentage composition						No. of analyses
	Water	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
CONCENTRATES, continued							
Bran, spring wheat	11.5	5.4	16.1	8.0	54.5	4.5	10
Bran, winter wheat	12.3	5.9	16.0	8.1	53.7	4.0	7
Middlings	12.1	3.3	15.6	4.6	60.4	4.0	32
Shorts	11.8	4.6	14.9	7.4	56.8	4.5	12
Wheat screenings	11.6	2.9	12.5	4.9	65.1	3.0	10
Rye	11.6	1.9	10.6	1.7	72.5	1.7	6
Rye flour	13.1	0.7	6.7	0.4	78.3	0.8	4
Rye bran	11.6	3.6	14.7	3.5	63.8	2.8	
Rye shorts	9.3	5.9	18.0	5.1	59.9	2.8	
Barley	10.9	2.4	12.4	2.7	69.8	1.8	10
Barley meal	11.9	2.6	10.5	6.5	66.3	2.2	3
Barley screenings	12.2	3.6	12.3	7.3	61.8	2.8	2
Brewers' grains, wet	75.7	1.0	5.1	3.8	12.5	1.6	15
Brewers' grains, dried	8.2	3.6	19.9	11.0	51.7	5.6	3
Malt-sprouts	10.2	5.7	23.2	10.7	48.5	1.7	4
Oats	11.0	3.0	11.8	9.5	59.7	5.0	30
Oat meal	7.9	2.0	14.7	0.9	67.4	7.1	6
Oat feed	7.7	3.7	16.0	6.1	59.4	7.1	4
Oat dust	6.5	6.9	13.5	18.2	50.2	4.8	2
Oat hulls	7.3	6.7	3.3	29.7	52.1	1.0	1
Rice	12.4	0.4	7.4	0.2	79.2	0.4	10
Rice meal	10.2	8.1	12.0	5.4	51.2	13.1	2
Rice hulls	8.2	13.2	3.6	35.7	38.6	0.7	3
Rice bran	9.7	10.0	12.1	9.5	49.9	8.8	5
Rice polish	10.0	6.7	11.7	6.3	58.0	7.3	4
Buckwheat	12.6	2.0	10.0	8.7	64.5	2.2	8
Buckwheat flour	14.6	1.0	6.9	0.3	75.8	1.4	4
Buckwheat hulls	13.2	2.2	4.6	43.5	35.3	1.1	2
Buckwheat bran	10.5	3.0	12.4	31.9	38.8	3.3	2
Buckwheat shorts	11.1	5.1	27.1	8.3	40.8	7.6	2
Buckwheat middlings	13.2	4.8	28.9	4.1	41.9	7.1	3
Sorghum seed	12.8	2.1	9.1	2.6	69.8	3.6	10
Broom-corn seed	11.5	3.4	10.2	7.1	63.6	3.0	2
Kafir seed	9.3	1.5	9.9	1.4	74.9	3.0	1
Millet seed	14.0	3.3	11.8	9.5	57.4	4.0	
Hungarian grass seed	9.5	5.0	9.9	7.7	63.2	4.7	
Flax seed	9.2	4.3	22.6	7.1	23.2	33.7	50
Flax seed, ground	8.1	4.7	21.6	7.3	27.9	30.4	2
Linseed meal, old process	9.2	5.7	32.9	8.9	35.4	7.9	21
Linseed meal, new process	10.1	5.8	33.2	9.5	38.4	3.0	14
Cotton seed	10.3	3.5	18.4	23.2	24.7	19.9	5
Cotton seed roasted	6.1	5.5	16.8	20.4	23.5	27.7	2
Cottonseed meal	8.2	7.2	42.3	5.6	23.6	13.1	35
Cottonseed hulls	11.1	2.8	4.2	46.3	33.4	2.2	20
Cottonseed kernels (without hulls)	6.2	4.7	31.2	3.7	17.6	36.6	2
Coconut cake	10.3	5.9	19.7	14.4	38.7	11.0	
Palm-nut meal	10.4	4.3	16.8	24.0	35.0	9.5	600
Sunflower seed	8.6	2.6	16.3	29.9	21.4	21.2	2
Sunflower-seed cake	10.8	6.7	32.8	13.5	27.1	9.1	
Peanut kernel (without hulls)	7.5	2.4	27.9	7.0	15.6	39.6	7
Peanut meal	10.7	4.9	47.6	5.1	23.7	8.0	2,480
Rape-seed cake	10.0	7.9	31.2	11.3	30.0	9.6	500
Pea meal	10.5	2.6	20.2	14.4	51.1	1.2	2
Soybean	10.8	4.7	34.0	4.8	28.8	16.9	8
Cowpea	14.8	3.2	20.8	4.1	55.7	1.4	5
Horse bean	11.3	3.8	26.6	7.2	50.1	1.0	1

TABLE I. AVERAGE COMPOSITION OF AMERICAN FEEDING-STUFFS, continued

Feeding-stuffs	Percentage composition: Water	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract	No. of analyses
ROUGHAGE							
Corn forage, field-cured—							
Fodder corn	42.2	2.7	4.5	14.3	34.7	1.6	35
Corn stover	40.5	3.4	3.8	19.7	31.5	1.1	60
Corn husks	50.9	1.8	2.5	15.8	28.3	0.7	16
Corn leaves	30.0	5.5	6.0	21.4	35.7	1.4	17
Corn forage, green—							
Fodder corn, all varieties	79.3	1.2	1.8	5.0	12 2	0.5	126
Dent varieties	79.0	1.2	1.7	5.6	12.0	0.5	63
Dent, kernels glazed	73.4	1.5	2 0	6.7	15 5	0 9	7
Flint varieties	79.8	1.1	2.0	4.3	12 1	0 7	40
Flint, kernels glazed	77.1	1.1	2 7	4 3	14 6	0.8	10
Sweet varieties	79.1	1.3	1.9	4.4	12.8	0.5	21
Leaves and husks	66.2	2.9	2.1	8.7	19.0	1.1	4
Stripped stalks	76.1	0.7	0.5	7.3	14.9	0.5	4
Hay from grasses—							
Hay from mixed grasses	15.3	5.5	7 4	27 2	42.1	2.5	126
Timothy, all analyses	13 2	4.4	5.9	29.0	45.0	2.5	68
Timothy, cut in full bloom	15 0	4.5	6.0	29 6	41.9	3.0	12
Timothy, cut soon after bloom	14 2	4.4	5 7	28.1	44.6	3.0	11
Timothy, cut when nearly ripe	14.1	3.9	5.0	31 1	43 7	2.2	12
Orchard-grass	9.9	6 0	8.1	32 4	41.0	2 6	10
Red-top, cut at different stages	8.9	5 2	7.9	28 6	47.5	1 9	9
Red-top, cut in bloom	8.7	4.9	8.0	29 9	46.4	2.1	3
Kentucky blue-grass	21.2	6.3	7.8	23.0	37.8	3.9	10
Kentucky blue-grass, cut when seed is in milk	24.4	7.0	6 3	24 5	34 2	3.6	4
Kentucky blue-grass, cut when seed is ripe	27.8	6.4	5.8	23 8	33 2	3.0	4
Hungarian grass	7.7	6.0	7.5	27 7	49 0	2.1	13
Meadow fescue	20 0	6.8	7.0	25.9	38.4	2.7	9
Italian rye-grass	8 5	6.9	7.5	30 5	45.0	1.7	4
Perennial rye-grass	14.0	7 9	10 1	25.4	40 5	2.1	4
Rowen (mixed)	16.6	6.8	11 6	22.5	39 4	3.1	23
Mixed grasses and clovers	12.9	5.5	10.1	27 6	41.3	2.6	17
Barley hay, cut in milk	15 0	4 2	8.8	24 7	44.9	2.4	1
Oat hay, cut in milk	15.0	5.2	9.3	29 2	39.0	2.3	1
Swamp hay	11.6	6 7	7.2	26.6	45.9	2.0	8
Salt-marsh hay	10.4	7.7	5.5	30.0	44.1	2.4	10
Wild-oat grass	14.3	3 8	5.0	25.0	48.8	3.3	1
Buttercups	9.3	5 6	9.9	30 6	41 1	3.5	2
White daisy	10.3	6.6	7.7	30.0	42 0	3.4	2
Johnson-grass	10.2	6.1	7.2	28.5	45.9	2.1	2
Fresh grass—							
Pasture grass	80.0	2.0	3.5	4.0	9.7	0.8	
Kentucky blue-grass	65 1	2.8	4.1	9.1	17.6	1.3	18
Timothy, different stages	61 6	2.1	3.1	11.8	20.2	1.2	56
Orchard-grass, in bloom	73 0	2.0	2 6	8.2	13.3	0.9	
Red-top, in bloom	65.3	2.3	2.8	11.0	17.7	0.9	
Oat fodder	62.2	2.5	3.4	11.2	19.3	1.4	6
Rye fodder	76.6	1.8	2.6	11.6	6.8	0.6	7
Sorghum fodder	79.4	1.1	1.3	6.1	11.6	0.5	11
Barley fodder	79.0	1.8	2.7	7.9	8.0	0.6	1
Hungarian grass	71.1	1.7	3.1	9 2	14.2	0.7	14
Meadow fescue, in bloom	69.9	1.8	2.4	10.8	14.3	0.8	4
Italian rye-grass, coming into bloom	73.2	2.5	3.1	6.8	13.3	1.3	24
Tall oat-grass, in bloom	69.5	2.0	2.4	9.4	15.8	0.9	3
Japanese millet	75.0	1.5	2.1	7.8	13.1	0.5	12
Barnyard millet	75.0	1.9	2.4	7.0	13.1	0.6	2
Hay from legumes—							
Red clover	15.3	6.2	12.3	24.8	38.1	3.3	38
Red clover in bloom	20.8	6.6	12.4	21.9	33.8	4.5	

TABLE I. AVERAGE COMPOSITION OF AMERICAN FEEDING-STUFFS, continued

Feeding-stuffs	Percentage composition						No. of analyses
	Water	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
ROUGHAGE, continued							
Hay from legumes, continued—							
Red clover, mammoth	21.2	6.1	10.7	24.5	33.6	3.9	10
Alsike clover	9.7	8.3	12.8	25.6	40.7	2.9	9
White clover	9.7	8.3	15.7	24.1	39.3	2.9	7
Crimson clover	9.6	8.6	15.2	27.2	36.6	2.8	7
Japan clover	11.0	8.5	13.8	24.0	39.0	3.7	2
Alfalfa	8.4	7.4	14.3	25.0	42.7	2.2	21
Cowpea	10.7	7.5	16.6	20.1	42.2	2.2	8
Soybean	11.3	7.2	15.4	22.3	38.6	5.2	6
Pea vine	15.0	6.7	13.7	24.7	37.6	2.3	1
Vetch	11.3	7.9	17.0	25.4	36.1	2.3	5
Serradella	9.2	7.2	15.2	21.6	44.2	2.6	3
Flat pea	8.4	7.9	22.9	26.2	31.4	3.2	5
Peanut vines (without nuts)	7.6	10.8	10.7	23.6	42.7	4.6	6
Sainfoin	15.0	7.3	14.8	20.4	39.5	3.0	1
Fresh legumes—							
Red clover, different stages	70.8	2.1	4.4	8.1	13.5	1.1	43
Alsike clover	71.8	2.0	3.9	7.4	11.0	0.9	4
Crimson clover	80.9	1.7	3.1	5.2	8.4	0.7	3
Alfalfa	71.8	2.7	4.8	7.4	12.3	1.0	23
Cowpea	83.6	1.7	2.4	4.8	7.1	0.4	10
Soybean	75.1	2.6	4.0	6.7	10.6	1.0	27
Serradella	79.5	3.2	2.7	5.4	8.6	0.7	9
Horse bean	84.2	1.2	2.8	4.9	6.5	0.4	2
Flat pea	66.7	2.9	8.7	7.9	12.2	1.6	2
Straw—							
Wheat	9.6	4.2	3.4	38.1	43.4	1.3	7
Rye	7.1	3.2	3.0	38.9	46.6	1.2	7
Oat	9.2	5.1	4.0	37.0	42.4	2.3	12
Barley	14.2	5.7	3.5	36.0	39.0	1.5	97
Wheat chaff	14.3	9.2	4.5	36.0	34.6	1.4	. .
Oat chaff	14.3	10.0	4.0	34.0	36.2	1.5	. .
Buckwheat-straw	9.9	5.5	5.2	43.0	35.1	1.3	3
Soybean	10.1	5.8	4.6	40.4	37.4	1.7	4
Horse bean	9.2	8.7	8.8	37.6	34.3	1.4	1
Silage—							
Corn	79.1	1.4	1.7	6.0	11.0	0.8	99
Sorghum	76.1	1.1	0.8	6.4	15.3	0.3	6
Red clover	72.0	2.6	4.2	8.4	11.6	1.2	5
Soybean	74.2	2.8	4.1	9.7	6.9	2.2	1
Apple pomace	85.0	0.6	1.2	3.3	8.8	1.1	1
Cowpea vine	79.3	2.9	2.7	6.0	7.6	1.5	2
Cowpea and soybean vines, mixed	69.8	4.5	3.8	9.5	11.1	1.3	1
Field-pea vine	50.1	3.5	5.9	13.0	26.0	1.6	1
Barnyard millet and soybean	79.0	2.8	2.8	7.2	7.2	1.0	9
Corn and soybean	76.0	2.4	2.5	7.2	11.1	0.8	4
Rye	80.8	1.6	2.4	5.8	9.2	0.3	1
Roots and tubers—							
Potato	78.9	1.0	2.1	0.6	17.3	0.1	12
Beets, common	88.5	1.0	1.5	0.9	8.0	0.1	9
Beets, sugar-	86.5	0.9	1.8	0.9	9.8	0.1	19
Beet, mangel	90.9	1.1	1.4	0.9	5.5	0.2	9
Turnip	90.5	0.8	1.1	1.2	6.2	0.2	3
Rutabaga	88.6	1.2	1.2	1.3	7.5	0.2	4
Carrot	88.6	1.0	1.1	1.3	7.6	0.4	8
Parsnip	88.3	0.7	1.6	1.0	10.2	0.2	. .
Artichoke	79.5	1.0	2.6	0.8	15.9	0.2	2
Sweet-potato	71.1	1.0	1.5	1.3	24.7	0.4	6

TABLE I. AVERAGE COMPOSITION OF AMERICAN FEEDING-STUFFS, continued

Feeding-stuffs	Percentage Composition: Water	Ash	Protein	Crude fiber	Nitrogen-free extract	Ether extract	No. of analyses
MISCELLANEOUS							
Cabbage	90.5	1.4	2.4	1.5	3.9	0.4	2
Spurry	75.7	4.0	2.0	4.9	12.7	0.8	1
Sugar-beet leaves	88.0	2.4	2.6	2.2	4.4	0.4	. .
Pumpkin (field)	90.9	0.5	1.3	1.7	5.2	0.4	.
Pumpkin (garden)	80.8	0.9	1.8	1.8	7.9	0.8	. .
Prickly comfrey	88.4	2.2	2.4	1.6	5.1	0.3	41
Rape	84.5	2.0	2.3	2.6	8.4	0.5	2
Acorns, fresh	55.3	1.0	2.5	4.4	34.8	1.9	. .
Apples	80.8	0.4	0.7	1.2	16.6	0.4	3
Cow's milk	87.2	0.7	3.6	. . .	4.9	3.7	793
Cow's milk, colostrum	74.6	1.6	17.6	. .	2.7	3.6	42
Mare's milk	91.0	0.4	2.1	. .	5.3	1.2	. .
Ewe's milk	81.3	0.8	6.3	. .	4.7	6.8	. .
Goat's milk	86.9	0.9	3.7	. .	4.4	4.1	.
Sow's milk	80.8	1.1	6.2	. .	4.8	7.1	7
Skim-milk, gravity	90.4	0.7	3.3	. .	4.7	0.9	96
Skim-milk, centrifugal	90.6	0.7	3.1	.	5.3	0.3	7
Buttermilk	90.1	0.7	4.0	. . .	4.0	1.1	85
Whey	93.8	0.4	0.6	. .	5.1	0.1	46
Dried blood	8.5	4.7	84.1	.	. . .	2.5	3
Meat scrap	10.7	4.1	71.2	.	0.3	13.7	144
Dried fish	10.8	29.2	48.4		. .	11.6	6
Beet pulp	89.8	0.6	0.9	2.4	6.3	. .	16
Beet molasses	20.8	10.6	9.1		59.5		35
Apple pomace	76.7	0.5	1.4	3.9	16.2	1.3	7
Sorghum bagasse	83.9	0.6	0.6	3.2	11.7*	. . .	2
Distillery slops	93.7	0.2	1.9	0.6	2.8	0.9	1
Dried sediment from distillery slops	5.0	11.3	27.4	8.0	36.1	12.3	1

* Includes fat

TABLE II. AVERAGE DIGESTIBILITY OF AMERICAN FEEDING-STUFFS, WITH ADDITIONS FROM THE GERMAN TABLES

A. *Experiments with Ruminants*

Feeding-stuffs	No. of trials	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract
CONCENTRATES		Per cent	Per cent	Per cent	Per cent	Per cent
Dent corn	12	91	76	58	93	86
Corn meal	5	88	60	. . .	93	92
Corn cob	2	59	17	65	60	50
Corn-and-cob meal	3	79	52	45	88	84
Gluten meal	8	87	88	. . .	88	93
Gluten meal (Chicago)	2	88	89	. . .	93	93
Gluten meal (King's)	2	81	91	.	79	94
Gluten feed	8	84	85	72	87	83
Gluten feed (Buffalo)	4	83	86	66	84	87
Gluten feed (Pope's)	2	87	86	77	90	81
Gluten feed (Peoria)	2	86	83	78	90	79
Gluten feed (Atlas)	2	80	73	.	84	91
Maize feed (Chicago)	2	84	84	72	85	90
Cream gluten (Pope's)	2	93	84	. .	88	98
Wheat bran	11	61	79	22	69	68
Wheat bran, spring	2	63	80	24	70	76
Wheat bran, winter	3	62	77	27	65	64
Wheat middlings	4	79	82	36	85	85
Rye meal	2	87	84	. . .	92	64
Barley	4	86	70	50	92	89
Malt-sprouts	1	67	80	34	69	100

TABLE II. AVERAGE DIGESTIBILITY OF AMERICAN FEEDING-STUFFS, continued

Feeding-stuffs	No. of trials	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract
CONCENTRATES, continued		Per cent	Per cent	Per cent	Per cent	Per cent
Brewers' grains, wet	12	63	73	40	62	86
Brewers' grains, dried	2	62	79	53	59	91
Oats	39	70	78	20	76	83
Rice meal	12	75	63	26	86	85
Flax seed	7		91	61	55	86
Linseed meal, old process	3	79	89	57	78	89
Linseed meal, new process	3	80	85	74	84	93
Cotton seed	2	66	68	76	50	87
Cotton seed, roasted	2	56	47	66	51	72
Cottonseed meal	6	76	88	32	64	93
Cottonseed hulls	13	41	6	47	34	79
Cottonseed hulls, when fed with cottonseed meal	3	41		38	49	78
Cottonseed hulls, when fed with cottonseed meal	11	45		46	51	76
Cottonseed feed (hulls and meal)	3	46	45	37	50	82
Cottonseed feed (hulls and meal)	11	55	62	46	54	85
Pea meal	2	87	83	26	94	55
Soybean meal	10	79	87		73	85
Peanut feed	2	32	71	12	49	90
ROUGHAGE						
Fodder corn, field-cured—						
Dent and flint varieties, average	23	68	55	65	73	74
Dent, mature	14	66	48	57	72	76
Dent, in milk	11	63	50	64	66	75
Dent, immature, B. & W. (coarse)	4	57	27	59	61	76
Dent, immature, no ears formed	8	65	62	71	64	66
Flint, mature	9	71	65	76	73	70
Flint, ears just forming	3	70	70	72	71	67
Sweet, mature	6	67	64	71	68	74
Corn stover, field-cured—						
Corn stover, all varieties		60	45	67	61	62
Corn stover		62	52	67	64	52
Corn stover, shredded, fed dry		57	40	65	56	72
Corn stover, shredded, fed wet		60	36	70	59	74
Corn stover, tops and blades		60	55	71	62	71
Corn stover, leaves		56	56	61	59	63
Corn stover, stalk below ear		67	21	74	69	80
Corn stover, stalk above ear		55	22	71	54	64
Corn stover, husks		72	30	80	. .	33
Corn stover, leaves below ear		65	35	78	68	56
Corn forage, green—						
Dent fodder corn, average, glazing and mature	13	66	53	52	74	76
Dent fodder corn, mature	4	65	51	55	72	73
Dent fodder corn, glazing	9	67	54	51	75	78
Dent fodder corn, in milk	9	70	61	64	76	78
Dent fodder corn, immature	11	68	66	67	71	68
Dent fodder corn, glazing, B. & W. (coarse)	2	52	24	46	59	78
Sweet fodder corn, roasting ear stage	6	72	62	60	77	79
Sweet fodder corn, in milk	2	77	77	75	81	74
Hay from grasses—						
Meadow hay, rich in protein	48	67	66	63	68	57
Meadow hay, medium in protein	94	61	57	60	64	53
Meadow hay, poor in protein	28	56	50	56	59	49
Timothy, all trials	26	57	48	52	63	57
Timothy, cut in bloom	5	60	56	58	63	57
Timothy, cut soon after bloom	10	53	45	47	60	53
Orchard-grass	3	56	60	61	55	55
Red-top	3	60	61	61	62	51
Hungarian grass	2	65	60	68	67	64
Mixed, rich in protein	20	58	58	60	59	48
Mixed, medium in protein	2	. . .	40	49	58	50
Rowen, average	8	65	68	66	64	47

TABLE II. AVERAGE DIGESTIBILITY OF AMERICAN FEEDING-STUFFS, continued

Feeding-stuffs	No. of trials	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract
ROUGHAGE, continued		Per cent	Per cent	Per cent	Per cent	Per cent
Hay from grasses, continued—						
Dried pasture grass	1	71	72	77	73	60
Barley hay	4	59	65	62	63	41
Oats and vetch	2	58	60	66	54	19
Timothy and clover, poorly cured	2	55	38	53	60	58
Blue-joint grass (*Calamagrostis Canadensis*) in bloom	2	69	70	72	69	52
Blue-joint grass, past bloom	1	40	57	37	43	37
Wild-oat grass (*Danthonica spicata*)	3	64	58	68	65	50
Pearl millet (*Pennisetum spicatum*)	2	62	63	67	59	46
Johnson-grass	1	55	45	58	54	39
Witch (quack) grass (*Agropyros repens*)	4	61	58	62	66	57
Sorghum fodder (leaves)	2	63	61	70	65	47
Sorghum bagasse (stalks after juice is removed)	1	61	14	64	65	46
Swamp hay	2	39	34	33	46	44
Salt hay of black grass (*Juncus Gerardi*)	2	60	63	60	56	41
Low meadow fox grass (*Spartina juncea*)	2	53	57	51	52	24
High-grown salt hay (largely *Spartina juncea*)	2	53	63	50	53	47
Branch grass (*Spartina juncea* with *Spartina stricta*, var. *glabra*)	2	56	62	52	54	31
Buttercups (*Ranunculus acris*)	2	56	56	41	67	70
White weed (Ox-eye daisy) (*Leucanthemum vulgare*)	2	58	58	46	67	62
Straw and chaff—						
Wheat-straw	7	43	11	52	38	31
Rye-straw	9	46	21	60	37	32
Oat-straw	19	48	30	54	44	33
Barley-straw	5	53	20	56	54	42
Soybean-straw	4	55	50	38	66	60
Oat chaff	2	42	38	45	49	48
Wheat chaff	2	26	6	37	29	34
Grasses, green—						
Pasture grasses, mixed	4	71	70	76	73	63
Timothy	5	58	50	52	64	47
Orchard-grass, in bloom	1	56	59	51	54	51
Oat fodder, in bloom	2	64	75	60	63	70
Rye, formation of heads	2	74	79	80	71	74
Sorghum, average	4	67	46	59	74	74
Barley, in bloom	4	67	72	61	71	60
Hungarian grass, early to late bloom	8	63	63	70	67	62
Barley and peas, full bloom	2	60	77	43	61	60
Oats and peas, bloom (?)	2	68	81	57	66	74
Rowen grass, mostly timothy, two-thirds grown	2	66	72	64	68	52
Hay from legumes—						
Red clover, in bloom	46	61	62	49	69	62
Red clover, late bloom, fair quality	2	55	55	46	64	53
Red clover, good quality	2	52	49	48	58	43
Alsike	3	62	66	53	71	50
White	1	66	73	61	70	51
Crimson	9	62	69	45	62	44
Alfalfa	28	60	74	43	66	39
Alfalfa, late bloom	2	. . .	77	49	64	54
Alfalfa, stage not given	1	. . .	69	43	72	48
Cowpea-vine, fair quality	2	59	65	43	71	50
Soybean	2	62	71	61	69	29
Vetch	6	65	76	54	66	60
Serradella, in bloom	2	62	75	50	63	65
Peanut vines	2	60	63	52	70	66
Sainfoin	2	62	70	36	74	66
Legumes, green—						
Red clover, late bloom	2	66	67	53	78	65
Rowen, late bloom	2	61	62	52	65	61
Crimson clover, late bloom	3	69	77	56	74	66

TABLE II. AVERAGE DIGESTIBILITY OF AMERICAN FEEDING-STUFFS, continued

Feeding-stuffs	No. of trials	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract
ROUGHAGE, continued		Per cent	Per cent	Per cent	Per cent	Per cent
Legumes, green, continued—						
Alfalfa	2	67	81	45	76	52
Cowpea, ready for soiling	2	76	74	57	84	59
Soybean, before bloom	2	66	79	50	72	54
Soybean, seed half grown	2	62	69	41	73	54
Canada peas, just before bloom	2	71	82	62	71	52
Silage—						
Dent corn, grain milk stage to mature	17	64	52	62	69	85
Dent corn, immature	13	64	54	70	66	71
Dent corn, stage uncertain	4	60	24	56	68	70
Dent corn, fine crushed (steers)	2	61	38	75	65	76
Dent corn, fine crushed (sheep)	2	54	22	64	55	68
Dent corn, uncooked, ears mature	1	. . .	45	59	71	86
Dent corn, cooked, ears mature	1	. . .	39	70	75	87
Flint, ears glazing	11	75	65	77	79	82
Sweet, some ears matured	2	68	54	71	72	83
Soybean	4	55	66	49	57	61
Cowpea-vine	4	60	57	52	72	63
Barnyard millet and soybean	4	59	57	69	59	72
Corn and soybean	3	69	65	65	75	82
Roots and tubers—						
Potato	23	85	61	. . .	90	. .
Potato	3	77	44	. . .	91	. .
Beet, mangel	18	88	77	. . .	96	. .
Beet, mangel	2	79	75	43	91	. .
Sugar-beet	28	89	62	. . .	95	. .
Sugar-beet	2	95	91	100	100	50
Turnip, flat	2	93	90	100	97	98
Rutabaga	2	87	80	74	95	84
MISCELLANEOUS						
Cow's milk	5	98	94	. . .	98	100
Acorns, fresh	2	88	83	62	91	88
Dried blood	2	63	62	. . .	100	100
Meat scrap	5	93	93	. . .	. . .	98
Fish guano	2	. . .	90	. . .	. . .	76
Beet pulp	7	82	63	83	84	. .

B. *Experiments with Pigs*

Feeding-stuffs	No. of trials	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract
		Per cent	Per cent	Per cent	Per cent	Per cent
Cornmeal	4	92	86	40	95	76
Cornmeal	2	90	88	39	94	80
Corn kernels, whole	1	83	69	38	89	46
Corn-and-cob meal	1	76	76	29	84	82
Pea meal	1	90	89	78	95	50
Barley meal	8	82	76	15	90	65
Barley meal	1	80	81	49	87	57
Wheat, whole	?	72	70	30	74	60
Wheat, cracked	?	82	80	60	83	70
Wheat shorts	2	77	73	37	87	. .
Wheat bran	2	61	75	34	66	72
Rye bran	2	67	66	9	75	58
Potato	8	93	73	55	98	. .
Potato	4	97	84	. . .	98	. .
Dried blood	1	72	72	. . .	92	. .
Flesh meal	8	92	97	. . .	. . .	87
Sour milk	1	95	96	. . .	90	95

TABLE III. AVERAGE DIGESTIBLE NUTRIENTS AND FERTILIZING CONSTITUENTS IN AMERICAN FEEDING-STUFFS

Name of feed	Dry matter in 100 Lbs.	Digestible nutrients in 100 Lbs.			Fertilizing constituents in 1,000 Lbs.		
		Protein	Carbo-hydrates	Ether extract	Nitrogen	Phosphoric acid	Potash
CONCENTRATES	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Corn, all analyses	89.1	7.9	66.7	4.3	18.2	7.0	4.0
Dent corn	89.4	7.8	66.7	4.3	16.5	...	..
Flint corn	88.7	8.0	66.2	4.3	16.8	...	..
Sweet corn	91.2	8.8	63.7	7.0	18.6	...	..
Corn cob	89.3	0.4	52.5	0.3	5.0	0.6	6.0
Corn-and-cob meal	84.9	4.4	60.0	2.9	14.1	5.7	4.7
Corn bran	90.9	7.4	59.8	4.6	16.3	12.1	6.8
Gluten meal	91.8	25.8	43.3	11.0	50.3	3.3	0.5
Germ meal	89.6	9.0	61.2	6.2	26.5	8.0	5.0
Starch refuse	91.8	11.4	58.4	6.5	22.4	7.0	5.2
Grano-gluten	94.3	26.7	38.8	12.4	49.8	5.1	1.5
Hominy chops	88.9	7.5	55.2	6.8	16.3	9.8	4.9
Glucose meal	91.9	30.3	35.3	14.5	57.7	...	..
Sugar meal	93.2	18.7	51.7	8.7	36.3	4.1	0.3
Gluten feed	92.2	20.4	48.4	8.8	38.4	4.1	0.3
Distillery grains (dried) principally corn	93.0	21.93	38.09	10.83	...	...	..
Atlas gluten feed (distillery by-products)	92.6	23.33	35.64	11.88	...	...	..
Wheat	89.5	10.2	69.2	1.7	23.6	7.9	5.0
High-grade flour	87.6	8.9	62.4	0.9	18.9	2.2	1.5
Low-grade flour	87.6	8.2	62.7	0.9	28.9	5.6	3.5
Dark feeding flour	90.3	13.5	61.3	2.0	31.8	21.4	10.9
Wheat bran	88.1	12.2	39.2	2.7	26.7	28.9	16.1
Wheat bran, spring	88.5	12.9	40.1	3.4	..	...	..
Wheat bran, winter	87.7	12.3	37.1	2.6	...	...	..
Wheat shorts	88.2	12.2	50.0	3.8	28.2	13.5	5.9
Wheat middlings	87.9	12.8	53.0	3.4	26.3	9.5	6.3
Wheat screenings	88.4	9.8	51.0	2.2	24.4	11.7	8.4
Rye	88.4	9.9	67.6	1.1	17.6	8.2	5.4
Rye bran	88.4	11.5	50.3	2.0	23.2	22.8	14.0
Rye shorts	90.7	11.9	45.1	1.6	18.4	12.6	8.1
Distillery grains (dried) principally rye	93.2	10.38	42.48	6.38	...	...	..
Barley	89.1	8.7	65.6	1.6	15.1	7.9	4.8
Malt-sprouts	89.8	18.6	37.1	1.7	35.5	14.3	16.3
Brewers' grains, wet	24.3	3.9	9.3	1.4	8.9	3.1	0.5
Brewers' grains, dried	91.8	15.7	36.3	5.1	36.2	10.3	0.9
Oats	89.0	9.2	47.3	4.2	20.6	8.2	6.2
Oat meal	92.1	11.5	52.1	5.9	23.5	...	..
Oat feed or shorts	92.3	12.5	46.9	2.8	17.2	9.1	5.3
Oat dust	93.5	8.9	38.4	5.1	21.6	..	..
Oat hulls	90.6	1.3	40.1	0.6	5.2	2.4	5.2
Rice	87.6	4.8	72.2	0.3	10.8	1.8	0.9
Rice hulls	91.8	1.6	44.5	0.6	5.8	1.7	1.4
Rice bran	90.3	5.3	45.1	7.3	7.1	2.9	2.4
Rice polish	90.0	9.0	56.4	6.5	19.7	26.7	7.1
Buckwheat	87.4	7.7	49.2	1.8	14.4	4.4	2.1
Buckwheat hulls	86.8	2.1	27.9	0.6	4.9	0.7	5.2
Buckwheat bran	89.5	7.4	30.4	1.9	36.4	17.8	12.8
Buckwheat shorts	88.9	21.1	33.5	5.5	...	...	..
Buckwheat middlings	87.3	22.0	33.4	5.4	42.8	21.9	11.4
Sorghum seed	87.2	7.0	52.1	3.1	14.8	8.1	4.2
Broom-corn seed	85.9	7.4	48.3	2.9	16.3	...	..
Kafir	84.8	7.8	57.1	2.7	...	...	..
Millet	86.0	8.9	45.0	3.2	20.4	8.5	3.6
Flax seed	90.8	20.6	17.1	29.0	36.1	13.9	10.3
Linseed meal, old process	90.8	29.3	32.7	7.0	54.3	16.6	13.7
Linseed meal, new process	89.9	28.2	40.1	2.8	57.8	18.3	13.9

TABLE III. AVERAGE DIGESTIBLE NUTRIENTS AND FERTILIZING CONSTITUENTS, continued

Name of feed	Dry matter in 100 Lbs.	Digestible nutrients in 100 Lbs			Fertilizing constituents in 1,000 Lbs.		
		Protein	Carbo hydrates	Ether extract	Nitrogen	Phosphoric acid	Potash
CONCENTRATES, continued	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs.
Cotton seed	89.7	12.5	30.0	17.3	31.3	12.7	11.7
Cottonseed meal	91.8	37.2	16.9	12.2	67.9	28.8	8 7
Cottonseed hulls	88.9	0.3	33.1	1.7	6.9	2.5	10.2
Coconut meal	89 7	15.6	38.3	10.5	32.8	16.0	24.0
Palm-nut meal	89 6	16.0	52.6	9.0	26 9	11.0	5.0
Sunflower seed	92.5	12.1	20.8	29.0	22.8	12.2	5.6
Sunflower-seed cakes	91.8	31.2	19.6	12.8	55.5	21 5	11.7
Peanut meal	89.3	42.9	22.8	6 9	75.6	13.1	15.0
Rape-seed meal	90.0	25.2	23.7	7 5	49.6	20.0	13.0
Peas	89.5	16.8	51.8	0.7	30.8	8.2	9 9
Soybean	89.2	29.6	22.3	14.4	53.0	18.7	19.0
Cowpea	85.2	18 3	54 2	1.1	33.3	...	..
Horse bean	85.7	22.4	49 3	1.2	40 7	12.0	12.9
ROUGHAGE							
Fodder corn—							
Fodder corn, green	20 7	1.0	11 6	0 4	4.1	1.5	3.3
Fodder corn, field-cured	57.8	2.5	34.6	1 2	17.6	5.4	8 9
Corn stover, field-cured	59.5	1 7	32.4	0 7	10.4	2.9	14.0
Fresh grass—							
Pasture grasses (mixed)	20.0	2 5	10 2	0.5	9.1	2 3	7.5
Kentucky blue-grass	34 9	3.0	19.8	0.8	...	...	..
Timothy, different stages	38 4	1.2	19.1	0.6	4.8	2.6	7.6
Orchard-grass, in bloom	27 0	1.5	11 4	0 5	4.3	1.6	7.6
Red-top, in bloom	34.7	2.1	21.2	0.6	...	...	..
Oat fodder	37.8	2.6	18.9	1.0	4.9	1.3	3.8
Rye fodder	23 4	2.1	14.1	0.4	3.3	1.5	7 3
Sorghum	20 6	0.6	12 2	0.4	2.3	0.9	2 3
Meadow fescue, in bloom	30.1	1.5	16 8	0 4	...	..	..
Hungarian grass	28.9	2 0	16 0	0.4	3 9	1.6	5.5
Green barley	21 0	1.9	10.2	0.4	..	...	..
Peas and oats	16.0	1 8	7 1	0 2	...	..	..
Peas and barley	16 0	1 7	7.2	0 2	...	...	..
Kafir fodder	27 0	0.87	13.80	0 43	...	...	..
Hay—							
Timothy	86 8	2 8	43 4	1.4	12 6	5.3	9.0
Orchard-grass	90.1	4.9	42.3	1.4	13.1	4.1	18.8
Red-top	91.1	4.8	46.9	1.0	11.5	3.6	10.2
Kentucky blue-grass	78.8	4.8	37.3	2 0	11.9	4.0	15.7
Hungarian grass	92.3	4 5	51 7	1 3	12.0	3.5	13.0
Mixed grasses	87.1	5.9	40.9	1.2	14.1	2.7	15 5
Rowen (mixed)	83 4	7.9	40.1	1.5	16.1	4.3	14.9
Meadow fescue	80.0	4.2	43.3	1.7	9.9	4.0	21.0
Mixed grasses and clover	87.1	6 16	42.71	1.46	...	...	.
Soybean hay	88.7	10.8	38.7	1.5	23.2	6.7	10 8
Oat hay	91.1	4.3	46.4	1.5	...	...	..
Marsh or swamp hay	88.4	2.4	29.9	0.9	...	...	..
Marsh or swamp hay	92 1	3.5	44.7	0.7	...	...	..
White daisy	85.0	3.8	40.7	1.2	...	...	..
Barley	89.4	5.11	35 94	1.55	...	...	..
Straw—							
Wheat	90.4	0.4	36.3	0.4	5.9	1.2	5.1
Rye	92.9	0.6	40.6	0.4	4.6	2.8	7.9
Oat	90.8	1.2	38.6	0.8	6.2	2.0	12.4
Barley	85.8	0.7	41.2	0.6	13.1	3.0	20.9
Wheat chaff	85.7	0.3	23.3	0.5	7.9	7.0	4.2
Oat chaff	85.7	1.5	33.0	0.7	...	...	..
Fresh legumes—							
Red clover, different stages	29.2	2.9	14.8	0.7	5.3	1.3	4.6
Alsike, bloom	25.2	2.7	13.1	0.6	4.4	1.1	2.0

TABLE III. AVERAGE DIGESTIBLE NUTRIENTS AND FERTILIZING CONSTITUENTS, continued

Name of feed	Dry matter in 100 Lbs.	Digestible nutrients in 100 Lbs.			Fertilizing constituents in 1,000 Lbs.		
		Protein	Carbo-hydrates	Ether extract	Nitrogen	Phosphoric acid	Potash
ROUGHAGE, continued	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	Lbs.
Fresh legumes—							
Crimson clover	19.1	2.4	9.1	0.5	4.3	1 3	4.9
Alfalfa	28.2	3.9	12.7	0.5	7 2	1.3	5.6
Cowpea	16.4	1.8	8 7	0.2	2 7	1 0	3 1
Soybean	24.9	3 2	11.0	0.5	2.9	1.5	5.3
Legume hay and straw—							
Red clover, medium	84.7	6.8	35.8	1.7	20.7	3.8	22.0
Red clover, mammoth	78 8	5.7	32.0	1.9	22.3	5.5	12 2
Alsike clover	90 3	8.4	42.5	1 5	23.4	6.7	22.3
White clover	90 3	11.5	42.2	1 5	27.5	5.2	18.1
Crimson clover	90 4	10.5	34.9	1.2	20.5	4.0	13.1
Alfalfa	91.6	11.0	39.6	1.2	21.9	5.1	16.8
Cowpea	89.3	10.8	38 6	1.1	19.5	5 2	14 7
Soybean-straw	89.9	2.3	40.0	1.0	17.5	4.0	13 2
Pea-vine-straw	86 4	4 3	32 3	0.8	14.3	3.5	10.2
Silage—							
Corn	20.9	0.9	11.3	0.7	2.8	1.1	3.7
Clover	28.0	2.0	13.5	1.0	. . .	. . .	. .
Sorghum	23.9	0.6	14.9	0.2	. . .	. . .	. .
Alfalfa	27.5	3.0	8.5	1 9	. . .	. . .	. .
Grass	32.0	1.9	13.4	1.6	. . .	. . .	. .
Cowpea vine	20.7	1.5	8.6	0.9	. . .	. . .	. .
Soybean	25 8	2.7	8 7	1.3	. . .	. . .	. .
Barnyard millet and soybean	21.0	1 6	9.2	0.7	. . .	. . .	. .
Corn and soybean	24 0	1.6	13.0	0.7	. . .	. . .	. .
Roots and tubers—							
Potato	21.1	0.9	16 3	0.1	3.2	1.2	4.6
Beet, common	13 0	1.2	8.8	0.1	2.4	0 9	4.4
Beet, sugar-	13 5	1.1	10 2	0.1	2.2	1 0	4.8
Beet, mangel	9.1	1.1	5 4	0 1	1.9	0.9	3.8
Flat turnip	9.5	1 0	7 2	0 2	1.8	1.0	3.9
Rutabaga	11 4	1 0	8.1	0.2	1.9	1.2	4.9
Carrot	11.4	0.8	7.8	0.2	1 5	0.9	5.1
Parsnip	11.7	1.6	11.2	0.2	1.8	2 0	4 4
Artichoke	20.0	2.0	16.8	0.2	2.6	1.4	4.7
MISCELLANEOUS							
Cabbage	15.3	1.8	8.2	0.4	3.8	1.1	4.3
Spurry	20.0	1.5	9.8	0.3	3.8	2.5	5.9
Sugar-beet leaves	12.0	1.7	4.6	0.2	4.1	1.5	6.2
Pumpkin, field	9.1	1.0	5.8	0.3	. . .	. . .	. .
Pumpkin, garden	19.2	1.4	8 3	0.8	1.1	1.6	0.9
Prickly comfrey	11.6	1.4	4.6	0.2	4.2	1.1	7.5
Rape	14.0	1.5	8.1	0.2	4.5	1.5	3.6
Acorns, fresh	44.7	2.1	34.4	1.7	. . .	. . .	. .
Dried blood	91.5	52.3	0.0	2.5	135.0	13.5	7.7
Meat scrap	89.3	66.2	0.3	13.7	113.9	7.0	1.0
Dried fish	89.2	44.1	0.0	10.3	77.5	120.0	2.0
Beet pulp	10.2	0.6	7.3	. . .	1.4	0.2	0.4
Beet molasses	79.2	9.1	59.5	0.0	14.6	0.5	56.3
Cow's milk	12.8	3.6	4.9	3.7	5.3	1.9	1.8
Cow's milk, colostrum	25.4	17.6	2.7	3.6	28.2	6.6	1.1
Skim-milk, gravity	9.6	3.1	4.7	0.8	5.6	2.0	1.9
Skim-milk, centrifugal	9.4	2.9	5.2	0.3	5.6	2.0	1.9
Buttermilk	9.9	3.9	4.0	1.1	4.8	1.7	1.6
Whey	6.6	0.8	4.7	0.3	1.5	1.4	1 8

METHOD OF EXACT BALANCING OF RATIONS

By *J. T. Willard*

Balancing a ration consists in choosing the feeds entering into it so that it will possess the proper weight, bulk and chemical composition for the animals to which it is to be fed, and for the immediate purpose in view in feeding them, whether for labor, growth, fattening, milk production or maintenance. The limits of this article will prevent any discussion of the subject in a broad way, and we will consider only the mode of calculating the quantities of the feeds chosen, in order to secure a ration having the chemical composition decided on as most suitable. Notwithstanding the fact that recent investigations are tending to minimize the importance of the balanced rations as hitherto held, the feeding standards thus secured must continue to be the guide in practical feeding operations for some time to come.

All observation and experiment have shown that there are certain bodily functions for which only nitrogenous constituents of feeds, that is protein, will serve, while there are others which are performed with greater physiological economy by non-nitrogenous substances. Hence there is, for each purpose and condition of feeding, between the digestible nitrogenous constituents of the ration and its digestible non-nitrogenous constituents, a ratio that is physiologically the most economical. This ratio is expressed not in terms of the relative weights of the constituents named but in terms of the relative quantities of energy yielded by them. Protein and carbohydrates are about equal, weight for weight, in energy-yielding power, but average fat of feeds yields about two and one-fourth times as much energy as an equal weight of average carbohydrates. What is known as the nutritive ratio of a feed or a ration is the ratio of the energy of its digestible protein to the energy of its digestible non-protein. It is equal, therefore, to the ratio of the weight of the digestible protein to the weight of the digestible carbohydrates plus two and one-fourth times the weight of the digestible fat. Thus, corn, having digestible protein, 7.14 per cent, carbohydrates, 66.12 per cent, and fat, 4.97 per cent, has a nutritive ratio of 7.14 : 66.12 + (2¼ x 4.97) or 7.14: 77.3. If we make the protein unity by dividing both terms of this ratio by 7 14, we do not alter its value, and we get it in a form that facilitates comparison with others. It thus becomes 1: 10.83. This means that for every unit of energy in the digestible protein of corn there are 10.83 units in the digestible carbohydrates and fat, the non-protein.

Rations can be best compared in respect to composition and digestibility by means of nutritive ratios. The principles of alligation are employed in this method of balancing rations, which consists essentially in balancing feeds in pairs, using, however, any feed as often as desired in balancing others. If it is desired to compound a ration in which the nutritive ratio shall be 1:6.5, using corn, corn stover and alfalfa hay, we find on making the necessary calculations that the nutritive ratio of corn is 1: 10.83, of corn stover, 1: 17.39, and of alfalfa, 1:3.82. The second terms of these ratios represent the non-protein. The first term, representing the protein, being made unity in each case, a comparison of the second terms is all that is necessary to disclose the relative predominance of non-protein. We see that, for each unit of energy in protein, alfalfa has less non-protein energy than the proposed ration, while corn-stover and corn each possesses an excess of non-protein energy. It must be clear that, since two of these feeds are too rich in non-protein while one is too poor, it is possible to use quantities of each that will produce a mixture having the desired nutritive ratio. As a matter of fact, when three or more such feeds are involved, an infinite number of proportions is possible, but there must be at least one feed that is richer in non-protein than the proposed ration, and at least one that is poorer in non-protein.

If we compare corn, alfalfa and the proposed ration as to second terms of nutritive ratios, we see that that of corn is 10.83 — 6.5 = 4.33 larger, while that of alfalfa is 6.5 — 3.82 = 2.68 smaller than the second term of the nutritive ratio of the proposed ration. The numbers 4.33 and 2.68 thus represent, in some sense, the excess and the deficiency of non-protein in corn and alfalfa, respectively. There is only one ratio in which these two feeds may be mixed to produce the desired nutritive ratio.

To balance corn and alfalfa to the nutritive ratio of 1:6.5, they must be taken in such quantities that the excess of non-protein in the total amount of corn used is exactly equal to the deficiency of non-protein in the total amount of alfalfa used.

If for each unit of protein in corn there is an excess of 4.33 units of non-protein, and for each unit of protein in alfalfa a deficiency of 2.68 units of non-protein, the excess from one and the deficiency of the other will be equal when we take enough corn to get 2.68 units of protein and enough alfalfa to get 4.33 units of protein. For, if with one unit of protein in corn we have an excess of 4.33 units of non-protein, with 2.68 units of protein, we should have an excess of 4.33 x 2.68 = 11.60 units of non-protein. Also, if with each unit of protein in alfalfa we have a deficiency of 2.68 units of non-protein, with 4.33 units of protein in alfalfa we should have 2.68 x 4.33 = 11.60 units of non-protein, and, this deficiency being exactly equal to the excess accompanying the corn, the mixture would be balanced to a nutritive ratio of 1:6.5.

What proportions by weight do these represent? If the amount of energy yielded by one pound of protein be taken as equal to one of the "units" just referred to, then the weight of corn that contains a pound of protein, multiplied by 2.68, will give the number of pounds of corn, and the weight of alfalfa that contains a pound of protein, multiplied by 4.33, will give the number of pounds of alfalfa. The weight of corn that contains a pound of protein is found by dividing 100 by the percentage of protein in corn. That is, if corn con-

tains 7.14 per cent of protein, each 100 pounds contains 7.14 pounds of protein, and 100 divided by 7.14 is the number of pounds of corn that contain one pound of protein. This quotient is called the protein-equating factor, and for corn it is 14.0. The protein-equating factor of alfalfa is 100÷10.58=9.45; that is, 9.45 pounds of alfalfa contain one pound of protein.

Substituting the protein-equating factors in the preceeding statements as the weights of the feeds that contain one pound of protein, we have 14.0 x 2.68=37.52 as the number of pounds of corn, and 9.45 x 4.33 = 40.92 as the number of pounds of alfalfa. Corn and alfalfa of the composition assumed, if mixed in the ratio of 37.52 to 40.92 only, will produce a ration with the nutritive ratio of 1: 6.5. If these two numbers be added together and each divided by the sum, the amounts required of each to produce one pound of the mixture will be obtained. These are .478 and .522 pounds.

Let us arrange in tabular form the data that by processes exactly similar to those described have been calculated for alfalfa and corn stover, balancing them to a nutritive ratio of 1:6.5. A tabular statement is also presented for the corn and alfalfa ration.

	Second term of ratio	Differ-ence		Protein equating factor		Relative quantities	
Mixture A—							
Corn stover	17.39	2.68	×	50.51	=	135.36	.568
Proposed ration	6.50	. .		. .			or
Alfalfa	3.82	10.89	×	9.45	=	102.91	.432
Mixture B—							
Corn	10.83	2.68	×	14.0	=	37.52	.478
Proposed ration	6.50	. .		. .			or
Alfalfa	3.82	4.33	×	9.45	=	40.88	.522

We have thus calculated two mixtures, A and B, each possessing the desired nutritive ratio. It is obvious that these two mixtures may be combined in any ratio whatever, and that thus there is possible an infinite number of compound mixtures of the three feeds, the nutritive ratio being 1:6.5 in each. As grain is found in B only, it will be seen that the ratio of grain to roughage can be made anything desired by proportioning properly the amounts of A and B in the compound mixture. It is very convenient to have the roughage and the concentrates of a ration separately balanced. The roughage may then be treated as a basal ration, with which greater or less quantities of the concentrate are fed according to individual needs. Of course the same care must be exercised in the choice of foods to be mixed as in the cut-and-try method, in order that the proper bulk and palatability may result.

Furthermore, by study of the detailed chemical composition of A and B, it has been found that the ratio of fat to carbohydrates in A is 1:38.02, while in B it is 1:16.55. By the use of alligation in a manner similar to that described in the foregoing, and employing fat-equating factors, it is possible to calculate the ratio in which A and B may be combined so as to produce a compound mixture having any desired ratio of fat to carbohydrates between 1:16.55 and 1:38.03.

By similar reasoning, if feeds in sufficient variety of composition are available, it is possible to calculate exactly the amounts of each to balance the ration, not only in respect to nutritive ratio and ratio of fat to carbohydrates, but in respect to percentage of digestible matter and other differences. To facilitate the work of computing the quantities of feed to be given, a table showing the nutritive ratio and the protein-equating factor of many of the common feeding-stuffs is here introduced. Fuller tables of composition and digestibility will be found in the preceding pages.

Table Showing the Nutritive Ratio and Protein-equating Factor of Common Feeding-stuffs

Feeding-stuff	Nutritive ratio	Protein-equating factor
Green and dry fodder—		
Corn fodder (av. all varieties)	1:11.7	90.9
Kafir fodder	1:17.0	114.9
Sorghum fodder	1:22.0	166.7
Rape	1: 4.3	46.3
Rye fodder	1: 7.4	48.8
Oat fodder	1: 8.3	41.0
Red-top in bloom	1:10.9	48.5
Orchard-grass, in bloom	1: 9.0	52.4
Meadow fescue, in bloom	1:11.9	67.1
Timothy, different stages	1:11.3	49.8
Kentucky blue-grass	1: 7.3	37.6
Hungarian grass	1: 8.6	52.1
Red clover, different stages	1: 5.3	32.6
Crimson clover	1: 4.8	46.3
Alfalfa, different stages	1: 3.1	25.7
Cowpea	1: 5.1	59.5
Soybean	1: 4.7	35.8
Sorghum silage	1:25.6	166.7
Corn silage (recent analyses)	1:13.7	82.6
Corn fodder, field-cured	1:14.9	42.7
Corn stover, field-cured	1:17.4	50.5
Green and dry fodder, continued—		
Kafir stover, field-cured	1:24.0	55.0
Kafir stover, field-cured (Kans.)	1:15.9	31.1
Sorghum fodder, cured	1:21 9	38.5
Hay from—		
Barley	1: 7.7	19.6
Oats	1: 9.1	24.6
Orchard-grass	1: 9.4	20.9
Red-top	1:10.2	20.8
Timothy (all analyses)	1:16.2	34.6
Kentucky blue-grass	1: 8.8	21.0
Hungarian grass	1:12.2	22.2
Meadow fescue	1:11.3	23.8
Mixed grasses	1:11.0	23.7
Rowen (mixed)	1: 6.2	13.9
Buffalo-grass	1: 7.2	16.1
Prairie-grass	1:84.2	163.9
Mixed grasses and clover	1: 7.5	16.2
Red clover	1: 5.7	13.6
Alsike clover	1: 5.5	12.3
White clover	1: 3.9	8.7

Feeding-stuff	Nutritive ratio	Protein-equating factor
Hay from—		
Crimson clover	1: 3.9	9.5
Alfalfa	1: 3.8	9.5
Alfalfa hay, first stage	1: 3.1	7.6
Alfalfa hay, second stage	1: 3.5	8.4
Alfalfa hay, third stage	1: 4.3	9.6
Cowpea	1: 3.9	9.3
Soybean	1: 3.9	9.3
Wheat-straw	1:100.5	270.3
Rye-straw	1: 65.8	158.7
Oat-straw	1: 33.6	83.3
Soybean-straw	1: 18.4	43.5
Roots and tubers—		
Potatoes	1: 12.1	73.5
Beets	1: 7.4	82.6
Beets, sugar-,	1: 9.5	90.9
Mangels	1: 5.7	97.1
Turnips	1: 8.3	123.5
Rutabagas	1: 9.1	112.5
Carrots	1: 10.3	123.5
Grains and other seeds—		
Corn (av. of dent and flint)	1: 10.8	14.0
Kafir	1: 9.8	17.3
Barley	1: 7.9	11.5
Oats	1: 6.2	10.8
Rye	1: 8.0	11.0
Wheat (all varieties)	1: 7.1	9.8
Cottonseed (whole)	1: 6.7	9.0
Mill products—		
Corn meal	1: 11.7	16.0
Corn-and-cob meal	1: 14.0	21.0
Oat meal	1: 5.7	8.7
Barley meal	1: 9.1	13.6
Ground corn and oats equal parts	1: 10.0	14.3
Pea meal	1: 3.2	6.0
Kafir meal	1: 8.9	16.3
Soybean meal	1: 2.1	2.8
By-products obtained in various industries—		
Gluten meal—		
Buffalo	1: 3.2	4.6
Chicago	1: 1.5	3.0
Hammond	1: 2.8	4.0
King	1: 2.3	3.3
Cream gluten (recent analyses)	1: 1.7	3.3
Gluten feed (recent analyses)	1: 3.3	5.0
Buffalo (recent analyses)	1: 2.5	4.3
Rockford (Diamond)	1: 3.1	4.9
Hominy chops	1: 9.1	11.9
Malt-sprouts	1: 2.5	5.3
Brewers' grains (wet)	1: 3.1	25.0
Brewers' grains (dried)	1: 2.4	5.3
Distillery grains (dried), principally corn	1: 2.8	4.6
Distillery grains (dried), principally rye	1: 5.5	9.6
Atlas gluten feed (distillery by-product)	1: 2.7	4.3
Rye bran	1: 4.9	8.7
Wheat bran (all analyses)	1: 4.0	8.3
Wheat middlings	1: 4.8	7.8
Wheat shorts	1: 4.8	8.2
Buckwheat bran	1: 2.2	5.2
Buckwheat middlings	1: 2.3	4.5
Cottonseed feed	1: 4.8	10.4
Cottonseed meal	1: 1.2	2.7
Cottonseed hulls	1: 34.7	95.2

Feeding-stuff	Nutritive ratio	Protein-equating factor
By-products obtained in various industries, continued—		
Linseed meal (old process)	1: 1.7	3.5
Linseed meal (new process)	1: 1.5	3.3
Sugar-beet pulp (fresh)	1: 11.3	158.7
Sugar-beet pulp (dry)	1: 9.6	14.7
Sugar-beet leaves	1: 3.0	58.8
Beet molasses	1: 6.1	11.0
Meat scrap	1: 0.5	1.5
Dried blood	1: 0.1	1.9
Milk and its by-products—		
Whole milk	1: 3.9	29.6
Skim-milk, cream raised by setting	1: 2.1	32.3
Skim-milk, cream raised by separator	1: 1.9	33.2
Buttermilk	1: 2.1	35.5
Whey	1: 9.3	178.6

Summary.

The following rules may be applied by any one in balancing feeds to a specified nutritive ratio:

To balance two feeds so that the resulting mixture shall have a certain nutritive ratio, it is essential that in the first of the feeds the second term of the nutritive ratio be larger than that of the proposed ration, and that in the second it be smaller. To ascertain the relative amounts to be taken to balance the two feeds:

Subtract the second term of the proposed nutritive ratio from the second term of the nutritive ratio of the first feed, and multiply the difference by the protein-equating factor of the second feed; the product will be the relative amount of the second feed.

Subtract the second term of the nutritive ratio of the second feed from the second term of the proposed nutritive ratio, and multiply the difference by the protein-equating factor for the first feed; the product will be the relative amount of the first feed.

If the numbers representing the relative amounts be added together, and each number divided by their sum, the quotients will be numbers representing the weights of each necessary to make one pound of the mixture; and, by multiplying these numbers by the weight of the ration to be compounded, the amount of each feed to be weighed is easily calculated.

It is obvious that calculating rations is much facilitated by tables which show the nutritive ratios and protein-equating factors for the several feeds, such as are inserted in this article. Tables have been calculated showing pairs of feeds balanced to the nutritive ratios of the most important rations.

Literature.

The reader should consult Bulletin No. 115, of the Kansas Agricultural Experiment Station, for full details of this method. In that bulletin, extensive tables of balanced mixtures are given, as well as much other helpful information.

COMPUTING BALANCED RATIONS

By *John L. Stone*

The principles of nutrition and the composition and digestibility of feeding-stuffs are discussed and tabulated in preceding pages. The purpose of this article is to indicate a practicable method by which busy farmers may determine approximately how to combine the various available food-stuffs so as best to meet the requirements of the various farm animals. It is well understood by the writer that the method pursued does not take into account all the recent results secured by investigators of nutrition problems. In regard to many feeds and some classes of animals, the necessary data are not available to enable this to be done. Again, the necessity of avoiding complicated computations, which the busy or unskilled would scarcely undertake, leads to disregarding certain factors in the feeding problem which, though important from the scientist's point-of-view, do not greatly affect results as secured by the practical feeder.

There are questions besides those having to do with the nutrients supplied in feeds, such as palatability, variety, bulk and condiments that, perhaps, call for mention in this connection.

Palatability.

This subject has received little attention at the hands of experimenters. In fact, palatability may be so intimately associated with other qualities of feeds as to render definite experimentation difficult. In the case of persons, we know that relish for given foods has much to do with their nutritive effect. In some cases of sickness, a chief consideration is to find foods that the patient will relish in order to nourish and build him up. It is not likely that the domestic animals are as susceptible to palatability as persons, but this quality will materially affect the completeness of consumption and, consequently, the percentage of waste. It will also affect the amount that the animal will eat, and when extreme production is sought this is a vital factor. So long as thorough assimilation is secured, it is the last pounds consumed that produce largest returns.

Variety.

This is closely associated with palatability. Many practical feeders and some experimenters have pointed out that animals thrive better when receiving several kinds of food rather than few, and this even though the latter may supply as much, or more, nutrients as the former. The probable explanation of this is that the variety adds to palatability and that thus a more abundant flow of secretions is secured, which leads to more thorough digestion and assimilation. At any rate, experience teaches the practical feeder that it pays to give attention to variety and to palatability in compounding rations.

Bulk.

In most cases, if the total dry matter is kept within allowable limits the bulk of the food will take care of itself. In exceptional cases, it may need looking after. Alfalfa hay and corn silage may be combined so that the nutritive ratio will conform to the standard for a dairy cow and the total dry matter not be very excessive, yet both being loose, porous materials, the bulk will be such that the cow cannot consume enough of it to provide for highest production. The reverse condition may also occur. Both should be avoided.

Condiments.

Numerous condimental foods and condition powders are advertised extensively and claims made that, when fed in small amounts, continuously, they wonderfully increase production of milk or meat. The basis of nearly all of these is corn, linseed or cottonseed meal and wheat middlings. Other ingredients are salt, fenugreek, gentian, ginger, sulfates of iron and soda, pepper, arsenic, potassium iodid, sulfur, iron (as venetian red, for color) and charcoal.

The effect that these substances might have on the animal system may be classed as condimental, tonic or alterative. In case of illness, one or another of these might well be administered for its medicinal effect, but there is nothing to show that the normal animal will be caused to produce more abundantly by their use. The effect of their continued use will depend on the amount administered and the condition of the animal. A stimulant or tonic action on an organ is followed by a reaction characterized by weakness and depression, and when carried to excess results in congestion and inflammation. Numerous experiments have failed to substantiate the claims put forth by the vendors of condimental foods, or the benefits that some feeders have fancied they derived from them.

In "Food in Health and Disease," Yeo remarks concerning condimental foods, "Many of these, by conferring agreeable flavors and by their warm, carminative properties promote appetite and assist digestion; but their excessive use is calculated to excite irritation and disorder of the digestive organs. In the great majority of cases, when tonic foods or condition powders appear to be necessary, they can be dispensed with, and usually to the advantage of the animal. Any real or apparent diseased condition that can be cured by the administration of an indiscriminate mixture of drugs can ordinarily be relieved with less danger to the patient by the adoption of a rational system of treatment and feeding. In those instances in which drugs are necessary, it is far better to employ one or more, adapted to the treatment of the particular ailment, than to attempt a cure by the administration of a "shot-gun" mixture, in the form of a patent food or condition powder. In the end, such specific treatment is infinitely less expensive, less dangerous and more satisfactory."

Nutritive ratio.

Since the protein on the one hand and the carbohydrates and fat on the other, serve, in the main, different purposes in the animal economy, it becomes evident that the relative amounts of these nutrients in the food are important. This relation

is expressed as the "nutritive ratio," which means the relation of digestible protein to digestible carbohydrates and fat—the fat having been multiplied by two and one-fourth before adding to the carbohydrates, for reasons explained in Dr. Armsby's article. The nutritive ratio is found by dividing the carbohydrates, plus two and one-fourth times the fat, by the protein. In the accompanying table the sum of the carbohydrates and fat, thus obtained, is given in the third column, which, divided by the protein as given in the second column, gives the second term of the nutritive ratio in the fifth column.

A feeding-stuff having a large proportion of carbohydrates and fat as compared to protein is said to have a "wide" nutritive ratio, while one having a small proportion of carbohydrates and fat as compared to protein has a "narrow" ratio. While these terms are relative, it may be said that a ratio greater than 1:6 is wide, while one less than 1:5 is narrow. The composition of feeding-stuffs, that is, the proportion in which the different nutrients occur, is determined by chemical analysis, but the amount of each nutrient that is actually digestible has been determined by careful experiments with living animals. Only the digestible nutrients are considered in the tables given in this article.

Feeding standards.

The amount of nutrients required and the proportions in which each should be given, varies with the kind of animal and the purpose for which it is kept: whether it is growing, being fattened, doing work, or producing milk or wool. Thus, an ox at rest requires less food and the various nutrients in different proportions than an ox at work; a cow producing a large flow of milk requires more food and the nutrients differently balanced than one producing less, or not producing.

Various investigators have condensed the results of many experiments and much practical experience into what are called "feeding standards," which attempt to state what in general, and under average conditions, is a good ration for the purpose in view. While these standards cannot be considered as mathematically exact, still the large number of practical feeders who testify to securing better results after approximating rations to the standards is warrant for continuing the use of this method till more scientific methods are worked out in simple form.

In table I, under the title of "feeding standards," are given the approximate requirements of various classes of animals and under varying conditions. These standards are mostly from German sources, but they have been found very helpful to American feeders. The standards are for animals of 1,000 pounds live weight, and may be increased or diminished for larger or smaller animals, though it is probable that the individuality of the animal, its power to assimilate and produce, will have more to do with the varying of the ration than its weight. It is permissible, perhaps, to depart from the amounts given in the first column under the head of "dry matter," more than in any other way. The digestive apparatus of farm animals is elastic and accommodates itself very readily to the varying bulk of its food. In the last column is given the nutritive ratio, which, perhaps, should be adhered to with some care, trusting to the appetite of the animal (which will be controlled largely by its power of digesting and producing) to indicate the amount of nutrients required. As a rule, the most rapid fattening or growth and abundant production are most economical, and these results are best secured by feeding an abundant and well-balanced ration (well up to the limit of the animal's appetite), while the dry matter is not permitted to rise much above the standard.

These standards pre-suppose comfortable stables for the animals during cold weather. If the stables are not comfortable, make them so if possible; but if the animals must be exposed to cold either indoors or out, it will be well to increase the amount of carbohydrates in the rations. On the other hand, if the stables are so constructed that the temperature never falls below 32° Fahr., a ration even narrower than that given in the standards may be fed to advantage.

TABLE I.—FEEDING STANDARDS.

A.—*Per day and* 1,000 *pounds live weight.**

	Dry matter	Digestible: Protein	Digestible: Carbohydrates and fat	Digestible: Total	Nutritive ratio
	Pounds	Pounds	Pounds	Pounds	
Oxen at rest in the stall	17.5	0.7	8.3	9.0	1:11.9
Wool sheep, coarser breeds	20.0	1.2	10.8	12.0	1:9.0
Wool sheep, finer breeds	22.5	1.5	12.0	13.5	1:8.0
Oxen moderately worked	24.0	1.6	12.0	13.0	1:7.5
Oxen heavily worked	26.0	2.4	14.3	16.7	1:6.0
Horses lightly worked	20.0	1.5	10.4	11.9	1:6.9
Horses moderately worked	21.0	1.7	11.8	13.5	1:6.9
Horses heavily worked	23.0	2.3	14.3	16.6	1:6.2
Milch cows, Wolff's standard	24.0	2.5	13.4	15.9	1:5.4

*The fattening rations are calculated for 1,000 pounds, live weight, at the beginning of the fattening.

TABLE I.—FEEDING STANDARDS, continued

A.—*Per day and 1,000 pounds live weight,** continued

		Dry matter	Digestible Protein	Digestible Carbohydrates and fat	Digestible Total	Nutritive ratio
		Pounds	Pounds	Pounds	Pounds	
Milch cows, when yielding daily—						
11 pounds milk		25.0	1.6	10.7	12.3	1:6.7
16.6 pounds milk		27.0	2.0	11.9	13.9	1:6.0
22.0 pounds milk		29.0	2.5	14.1	16.6	1:5.7
27.5 pounds milk		32.0	3.3	14.8	18.1	1:4.5
Fattening oxen, preliminary period		27.0	2.5	16.1	18.6	1:6.4
Fattening oxen, main period		26.0	3.0	16.4	19.4	1:5.5
Fattening oxen, finishing period		25.0	2.7	16.2	18.9	1:6.0
Fattening sheep, preliminary period		26.0	3.0	16.3	19.3	1:5.4
Fattening sheep, main period		25.0	3.5	15.8	19.3	1:4.5
Fattening swine, preliminary period		36.0	5.0	27.5	32.5	1:5.5
Fattening swine, main period		31.0	4.0	24.0	28.0	1:6.0
Fattening swine, finishing period		23.5	2.7	17.5	20.2	1:6.5
Growing cattle:						
Age (months).	*Average live weight per head.*					
2–3	150 lbs.	22.0	4.0	18.3	22.3	1:4.6
3–6	300 lbs.	23.4	3.2	15.8	19.0	1:4.9
6–12	500 lbs.	24.0	2.5	14.9	17.4	1:6.0
12–18	700 lbs.	24.0	2.0	13.9	15.9	1:7.0
18–24	850 lbs.	24.0	1.6	12.7	14.3	1:8.0
Growing sheep:						
5–6	56 lbs.	28.0	3.2	17.4	20.6	1:5.4
6–8	67 lbs.	25.0	2.7	14.7	17.4	1:5.4
8–11	75 lbs.	23.0	2.1	12.5	14.6	1:6.0
11–15	82 lbs.	22.5	1.7	11.8	13.5	1:7.0
15–50	85 lbs.	22.0	1.4	11.1	12.5	1:8.0
Growing fat pigs:						
2–3	50 lbs.	42.0	7.5	30.0	37.5	1:4.0
3–5	100 lbs.	34.0	5.0	25.0	30.0	1:5.0
5–6	125 lbs.	31.5	4.3	23.7	28.0	1:5.5
6–8	170 lbs.	27.0	3.4	20.4	23.8	1:6.0
8–12	250 lbs.	21.0	2.5	16.2	18.7	1:6.5

B. *Per day and per head*

		Dry matter	Digestible Protein	Digestible Carbohydrates and fat	Digestible Total	Nutritive ratio
Growing cattle:		Pounds	Pounds	Pounds	Pounds	
2–3	150 lbs.	3.3	0.6	2.8	3.4	1:4.6
3–6	300 lbs.	7.0	1.0	4.9	5.9	1:4.9
6–12	500 lbs.	12.0	1.3	7.5	8.8	1:6.0
12–18	700 lbs.	16.8	1.4	9.7	11.1	1:7.0
18–24	850 lbs.	20.4	1.4	11.1	12.5	1:8.0
Growing sheep:						
5–6	56 lbs.	1.6	0.18	0.974	1.154	1:5.4
6–8	67 lbs.	1.7	0.18	0.981	1.161	1:5.4
8–11	75 lbs.	1.7	0.16	0.953	1.113	1:6.0
11–15	82 lbs.	1.8	0.14	0.975	1.115	1:7.0
15–20	85 lbs.	1.9	0.12	0.955	1.075	1:8.0
Growing fat swine:						
2–3	50 lbs.	2.1	0.38	1.50	1.88	1:4.0
3–5	100 lbs.	3.4	0.50	2.50	3.00	1:5.0
5–6	125 lbs.	3.9	0.54	2.96	3.50	1:5.5
6–8	170 lbs.	4.6	0.58	3.47	4.05	1:6.0
8–12	250 lbs.	5.2	0.62	4.05	4.67	1:6.5

* The fattening rations are calculated for 1,000 pounds, live weight, at the beginning of the fattening.

Table II gives a list of the feeding-stuffs in most common use. Column one is headed "dry matter"; column two, "digestible protein"; column three, "digestible carbohydrates + (fat × 2¼)"; column four, "total" (which is the sum of two and three); column five, "nutritive ratio." In each of these columns is given the computation of the various food-stuffs from one pound up to the amount that is likely to be used in compounding any ration. In the case of the coarse fodders, to save space, the increase is made by more than one pound at a time, but intermediate amounts can readily be obtained from the table if desired. In no case are the calculations for ten pounds of a feeding-stuff given, as these can be obtained at once from the figures for one pound, simply by moving the decimal point one place to the right.

These computations are based on the table of "Average Digestible Nutrients in American Feeding-Stuffs," given on pages 96–99, adapted from Henry's "Feeds and Feeding." The aim has been to carry the computations involved in formulating rations as near completion as possible, and to present the figures in such simple form that no feeder will have difficulty in comparing the ration he is feeding with the standards and correcting it, if necessary, to conform thereto. A little time and thought may be thus invested to advantage.

TABLE II.—DIGESTIBLE NUTRIENTS IN THE STATED AMOUNTS OF THE MORE COMMON FEEDING-STUFFS.

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients: Protein	Carbohydrates + (fat×2.25)	Total	Nutritive ratio
Soiling fodder—					
Fodder corn, 1 lb.	.20	.010	.125	.135	1:12.5
" " 5 lbs.	1.00	.050	.625	.675	
" " 15 "	3.00	.150	1.875	2.025	
" " 20 "	4.00	.200	2.500	2.700	
" " 25 "	5.00	.250	3.125	3.375	
" " 30 "	6.00	.300	3.750	4.050	
" " 35 "	7.00	.350	4.375	4.725	
" " 40 "	8.00	.400	5.000	5.400	
Peas-and-oats, 1 lb.	.16	.018	.076	.094	1:4.2
" 5 lbs.	.80	.090	.380	.470	
" 15 "	2.40	.270	1.140	1.410	
" 20 "	3.20	.360	1.520	1.880	
" 25 "	4.00	.450	1.900	2.350	
" 30 "	4.80	.540	2.280	2.820	
" 35 "	5.60	.630	2.660	3.290	
" 40 "	6.40	.720	3.040	3.760	
Peas-and-barley	.16	.017	.077	.094	1:4.5
Practically the same as peas-and-oats					
Red clover, 1 lb.	.29	.029	.164	.193	1:5.6
" " 5 lbs.	1.45	.145	.820	.965	
" " 15 "	4.35	.435	2.460	2.895	
" " 20 "	5.80	.580	3.280	3.860	
" " 25 "	7.25	.725	4.100	4.825	
" " 30 "	8.70	.870	4.920	5.790	
" " 35 "	10.15	1.015	5.740	6.755	
" " 40 "	11.60	1.160	6.560	7.720	
Alfalfa, 1 lb.	.28	.039	.138	.177	1:3.5
" 5 lbs.	1.40	.195	.690	.885	
" 15 "	4.20	.585	2.070	2.655	
" 20 "	5.60	.780	2.760	3.540	
" 25 "	7.00	.975	3.450	4.425	
" 30 "	8.40	1.170	4.140	5.310	
" 35 "	9.80	1.365	4.830	6.195	
" 40 "	11.20	1.560	5.520	7.080	
Hungarian grass, 1 lb.	.29	.020	.169	.189	1:8.4
" " 5 lbs.	1.45	.100	.845	.945	
" " 15 "	4.35	.300	2.535	2.835	
" " 20 "	5.80	.400	3.380	3.780	
" " 25 "	7.25	.500	4.225	4.725	
" " 30 "	8.70	.600	5.070	5.670	
" " 35 "	10.15	.700	5.915	6.615	
" " 40 "	11.60	.800	6.760	7.560	

TABLE II.—DIGESTIBLE NUTRIENTS IN THE STATED AMOUNTS OF THE MORE COMMON FEEDING-STUFFS, continued.

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients: Protein	Carbohydrates+ (fat×2 25)	Total	Nutritive ratio
Soiling fodder, continued—					
Corn silage, 1 lb.	.21	.009	.129	.138	1:14 3
" " 5 lbs.	1.05	.045	.645	.690	
" " 15 "	3.15	.135	1.935	2.070	
" " 20 "	4 20	.180	2.580	2.760	
" " 25 "	5 25	.225	3.225	3.450	
" " 30 "	6.30	.270	3 870	4.140	
" " 35 "	7 35	.315	4 515	4.830	
" " 40 "	8.40	.360	5.160	5.520	
" " 45 "	9.45	.405	5 805	6.210	
" " 50 "	10 50	.450	6.450	6.900	
Roots and tubers—					
Potatoes, 1 lb.	21	.009	165	.174	1:18.3
" 5 lbs.	1.05	.045	825	.870	
" 15 "	3 15	.135	2 475	2 610	
" 20 "	4.20	.180	3.300	3.480	
" 25 "	5.25	.225	4.125	4.350	
Beet, mangel, 1 lb.	.09	.011	.056	.067	1:5.1
" " 5 lbs.	.45	.055	.280	.335	
" " 15 "	1 35	.165	.840	1.005	
" " 20 "	1.80	.220	1.120	1.340	
" " 25 "	2.25	275	1.400	1 675	
" " 30 "	2.70	.330	1 680	2.010	
Beet, sugar-, 1 lb.	.13	.011	104	.115	1.9.4
" " 5 lbs.	65	.055	.520	.575	
" " 15 "	1.95	.165	1.560	1.725	
" " 20 "	2.60	220	2 080	2.300	
" " 25 "	3 25	275	2.600	2.875	
" " 30 "	3 90	.330	3.120	3 450	
Carrot, 1 lb.	.11	008	082	.090	1.10.3
" 5 lbs.	.55	.040	.410	.450	
" 15 "	1.65	.120	1.230	1.305	
" 20 "	2 20	160	1 640	1.800	
" 25 "	2.75	200	2.050	2 250	
" 30 "	3.30	.240	2.460	2 700	
Flat turnip, 1 lb.	.10	.010	.077	087	1:7.7
" " 5 lbs.	.50	.050	.385	.435	
" " 15 "	1 50	.150	1.155	1.350	
" " 20 "	2 00	.200	1.540	1.740	
" " 25 "	2 50	.250	1.925	2.175	
" " 30 "	3.00	.300	2.310	2.610	
Hay and straw—					
Timothy, 1 lb.	.87	.028	.465	.493	1:16.6
" 3 lbs.	2.61	.084	1.395	1.479	
" 5 "	4.35	.140	2.325	2.465	
" 7 "	6.09	.196	3.255	3.451	
" 8 "	6.96	.224	3.720	3.944	
" 9 "	7.83	252	4.185	4.437	
" 12 "	10.44	.336	5.580	5.916	
" 15 "	13.05	.420	6.975	7.395	
" 18 "	15.66	.504	8.370	8.874	
" 20 "	17.40	.560	9.300	9.860	
Mixed grasses and clover, 1 lb.	.87	.062	.460	.522	1:7.4
" " " 3 lbs.	2.61	.186	1.381	1.566	
" " " 5 "	4.35	.310	2.300	2.610	
" " " 7 "	6.09	.434	3.220	3.654	
" " " 8 "	6.96	.496	3.680	4.176	
" " " 9 "	7.83	.558	4.140	4.698	

TABLE II.—DIGESTIBLE NUTRIENTS IN THE STATED AMOUNTS OF THE MORE COMMON FEEDING-STUFFS, continued.

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients			Nutritive ratio
		Protein	Carbohydrates+ (fat×2.25)	Total	
Hay and straw, continued—					
Mixed grasses and clover, 12 lbs.	10.44	.744	5.520	6.264	
" " " 15 "	13 05	.930	6.900	7.830	
" " " 18 "	15.66	1.116	8.280	9.396	
" " " 20 "	17 40	1.240	9.200	10.440	
Hungarian hay, 1 lb.	.92	.045	.546	.591	1:12.1
" " 3 lbs.	2.76	.135	1.638	1.773	
" " 5 "	4.60	.225	2.730	2.955	
" " 7 "	6.44	.315	3.822	4.137	
" " 8 "	7.36	.360	4.368	4.728	
" " 9 "	8.28	.405	4.914	5.319	
" " 12 "	11.04	.540	6.552	7.092	
Red clover hay, 1 lb.	.85	.068	.396	.464	1:5.8
" " 3 lbs.	2.55	.204	1.188	1.392	
" " 5 "	4.25	.340	1.980	2.320	
" " 7 "	5.95	.476	2.772	3.248	
" " 8 "	6.80	.544	3.168	3.712	
" " 9 "	7.65	.612	3.564	4.176	
" " 12 "	10.20	.816	4.752	5.568	
" " 15 "	12.75	1.020	5.940	6.960	
" " 18 "	15.30	1.224	7.128	8.352	
" " 20 "	17.00	1.360	7.920	9.280	
Alfalfa hay, 1 lb.	.92	.110	.423	.533	1:3.8
" " 3 lbs.	2 76	.330	1.269	1.599	
" " 5 "	4.60	.550	2.115	2.665	
" " 7 "	6.44	.770	2.961	3.731	
" " 8 "	7.36	.880	3.384	4.264	
" " 9 "	8 28	.990	3.807	4.797	
" " 12 "	11.04	1.320	5.076	6.396	
" " 15 "	12.80	1.650	6.345	7.995	
" " 18 "	16.56	1.980	7.614	9.594	
" " 20 "	18.40	2.200	8.460	10 660	
Corn fodder, 1 lb.	.58	.025	.373	.398	1:14.9
" " 5 lbs.	2.90	.125	1.865	1.990	
" " 8 "	4.64	.200	2.984	3.184	
" " 12 "	6.96	.300	4.476	4.776	
" " 15 "	8.70	.375	5.595	5.970	
" " 18 "	10.44	.450	6.714	7.164	
" " 20 "	11.60	.500	7.460	7.960	
Corn stover, 1 lb.	60	.017	.340	.357	1:19.9
" " 5 lbs.	3.00	.085	1.720	1.805	
" " 8 "	4.80	.136	2.720	2.856	
" " 12 "	7.20	.204	4.080	4.284	
" " 15 "	9.00	.255	5.160	5.415	
" " 18 "	10.80	.306	6.120	6.426	
" " 20 "	12.00	.340	6.880	7.220	
Pea-vine-straw, 1 lb.	.86	.043	.341	.384	1:7.9
" " 3 lbs.	2.58	.129	1.023	1.152	
" " 5 "	4.30	.215	1.705	1.920	
" " 8 "	6.88	.344	2.728	3.072	
" " 12 "	10.32	.516	4.092	4.608	
" " 15 "	12.90	.645	5.115	2.760	
Bean-straw, 1 lb.	.95	.036	.397	.433	1:11.0
" 2 lbs.	1.90	.072	.794	.866	
" 3 "	2.85	.108	1.191	1.299	
" 4 "	3.80	.144	1.588	1.732	
" 5 "	4.75	.180	1.985	2.165	
" 7 "	6.65	.252	2.779	3.031	

TABLE II.—DIGESTIBLE NUTRIENTS IN THE STATED AMOUNTS OF THE MORE COMMON FEEDING-STUFFS, continued.

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients			Nutritive ratio
		Protein	Carbohydrates+ (fat×2 25)	Total	
Hay and straw, continued—					
Bean-straw, 9 lbs.	8.55	.324	3.573	3.897	
" 12 "	11.40	.432	4.764	5.196	
Wheat-straw, 1 lb.	.90	.004	.372	.376	1:93
" 3 lbs.	2.70	.012	1.016	1.128	
" 5 "	4.50	.020	1.860	1.880	
" 8 "	7.20	.032	2.976	3.008	
" 12 "	10.80	.048	4.064	4.512	
" 15 "	13.50	.060	5 580	5.640	
Oat-straw, 1 lb.	.91	.012	.404	.416	1:33.6
" 3 lbs.	2.73	.036	1.212	1.248	
" 5 "	4.55	.060	2.020	2.080	
" 8 "	7.28	.096	3.232	3.328	
" 12 "	10.92	.144	4.848	4.992	
" 15 "	13.65	.180	6 060	6.240	
Grain—					
Corn (av.), 1 lb.	.89	.079	764	.843	1:9.7
" 2 lbs.	1.78	.158	1 528	1.686	
" 3 "	2 67	237	2 292	2.529	
" 4 "	3.56	.316	3 056	3.372	
" 5 "	4.45	.395	3.820	4.215	
" 6 "	5.34	.474	4 584	5.058	
" 7 "	6.23	.553	5.348	4.901	
" 8 "	7.12	.632	6.112	6.744	
" 9 "	8.01	.711	6.876	7.587	
Wheat, 1 lb.	.90	.102	.730	.832	1:7.2
" 2 lbs.	1.80	.204	1 460	1.664	
" 3 "	2.70	.306	2.190	2.496	
" 4 "	3.60	.408	2.920	3.328	
" 5 "	4.50	.510	3.650	4.160	
" 6 "	5.40	.612	4.380	4.992	
Rye, 1 lb.	.88	099	.700	.799	1:7.1
" 2 lbs.	1.76	.198	1.400	1.598	
" 3 "	2.64	.297	2.100	2.397	
" 4 "	3.52	.396	2.800	3.196	
" 5 "	4.40	.495	3.500	3.995	
" 6 "	5.28	.594	4 200	4.794	
Barley, 1 lb.	.89	.087	.692	.779	1:7.9
" 2 lbs.	1.78	.174	1.384	1.558	
" 3 "	2.67	.261	2 076	2.337	
" 4 "	3.56	.348	2.768	3.116	
" 5 "	4.45	.435	3.460	3.895	
" 6 "	5.34	.522	4 152	4.674	
Oats, 1 lb.	.89	.092	568	.660	1:6.2
" 2 lbs.	1.78	.184	1.136	1.320	
" 3 "	2.67	.276	1.704	1.980	
" 4 "	3.56	.368	2.272	2.640	
" 5 "	4.45	.460	2.840	3.300	
" 6 "	5.34	.552	3.408	3.960	
" 7 "	6.23	.644	3.976	4.620	
" 8 "	7.12	.736	4.544	5.280	
" 9 "	8.01	.828	5.112	5.940	
" 12 "	10.68	1.104	6.816	7.920	
" 15 "	13.35	1.380	8.520	9.900	
Buckwheat, 1 lb.	.87	.077	.533	.610	1:6.9
" 2 lbs.	1.74	.154	1.066	1.220	
" 3 "	2.61	.231	1.599	1.830	

TABLE II.—DIGESTIBLE NUTRIENTS IN THE STATED AMOUNTS OF THE MORE COMMON FEEDING-STUFFS, continued.

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients			Nutritive ratio
		Protein	Carbohydrates + (fat×2.25)	Total	
Grain, continued—					
Buckwheat, 4 lbs.	3.48	.308	2.132	2.440	
" 5 "	4.35	.385	2.665	3.050	
" 6 "	5.22	.462	3.198	3.660	
" 7 "	6.09	.539	3.731	4.270	
" 8 "	6.96	.616	4.264	4.880	
" 9 "	7.83	.693	4.797	5.490	
Peas, 1 lb.	.90	.168	.534	.702	1:3.2
" 2 lbs.	1.80	.336	1.068	1.404	
" 3 "	2.70	.504	1.602	2.106	
" 4 "	3.60	.672	2.136	2.808	
" 5 "	4.50	.840	2.670	3.510	
" 6 "	5.40	1.008	3.204	4.212	
" 7 "	6.30	1.176	3.738	4.914	
" 8 "	7.20	1.344	4.272	5.616	
" 9 "	8.10	1.512	4.806	6.318	
Mill products—					
Corn-and-cob meal, 1 lb.	.85	.044	.665	.709	1:15.1
" " 2 lbs.	1.70	.088	1.330	1.418	
" " 3 "	2.55	.132	1.995	2.127	
" " 4 "	3.40	.176	2.660	2.836	
" " 5 "	4.25	.220	3.325	3.545	
" " 6 "	5.10	.264	3.990	4.254	
" " 7 "	5.95	.308	4.655	4.963	
" " 8 "	6.80	.352	5.320	5.672	
" " 9 "	7.65	.396	5.985	6.381	
" " 12 "	10.20	.528	7.980	8.508	
Wheat bran, 1 lb.	.88	.122	.453	.575	1:3.7
" " 2 lbs.	1.76	.244	.906	1.150	
" " 3 "	2.64	.366	1.359	1.725	
" " 4 "	3.52	.488	1.812	2.300	
" " 5 "	4.40	.610	2.265	2.875	
" " 6 "	5.28	.732	2.718	3.450	
" " 7 "	6.16	.854	3.171	4.025	
" " 8 "	7.04	.976	3.624	4.600	
" " 9 "	7.92	1.098	4.077	5.175	
Wheat middlings, 1 lb.	.88	.128	.607	.735	1:4.7
" " 2 lbs.	1.76	.256	1.214	1.470	
" " 3 "	2.64	.384	1.821	2.205	
" " 4 "	3.52	.512	2.428	2.940	
" " 5 "	4.40	.640	3.035	3.675	
" " 6 "	5.28	.768	3.642	4.410	
" " 7 "	6.16	.896	4.249	5.145	
" " 8 "	7.04	1.024	4.856	5.880	
" " 9 "	7.92	1.152	5.463	6.615	
Dark feeding flour, 1 lb.	.90	.135	.658	.793	1:4.9
" " " 2 lbs.	1.80	.270	1.316	1.586	
" " " 3 "	2.70	.405	1.974	2.379	
" " " 4 "	3.60	.540	2.632	3.172	
" " " 5 "	4.50	.675	3.290	3.965	
" " " 6 "	5.40	.810	3.948	4.758	
" " " 7 "	6.30	.945	4.606	5.551	
" " " 8 "	7.20	1.080	5.264	6.344	
" " " 9 "	8.10	1.215	5.922	7.137	
Low grade flour, 1 lb.	.88	.082	.647	.729	1:7.9
" " " 2 lbs.	1.76	.164	1.294	1.458	
" " " 3 "	2.64	.246	1.941	2.187	
" " " 4 "	3.52	.328	2.588	2.916	
" " " 5 "	4.40	.410	3.235	3.645	

TABLE II.—DIGESTIBLE NUTRIENTS IN THE STATED AMOUNTS OF THE MORE COMMON FEEDING-STUFFS, continued.

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients: Protein	Carbohydrates + (fat×2.25)	Total	Nutritive ratio
Milk products, continued—					
Low grade flour, 6 lbs.	5.28	.492	3.882	4.374	
" " " 7 "	6.16	.574	4.529	5.103	
" " " 8 "	7.04	.656	5.176	5.832	
" " " 9 "	7.92	.738	5.823	6.561	
Rye bran, 1 lb.	.88	.115	.548	.663	1:4.8
" " 2 lbs.	1.76	.230	1.096	1.326	
" " 3 "	2.64	.345	1.644	1.989	
" " 4 "	3.52	.460	2.192	2.652	
" " 5 "	4.40	.575	2.740	3.315	
" " 6 "	5.28	.690	3.288	3.978	
" " 7 "	6.16	.805	3.836	4.641	
" " 8 "	7.04	.920	4.384	5.304	
" " 9 "	7.92	1.035	4.952	5.967	
Buckwheat bran, 1 lb.	.90	.074	.347	.421	1:4.7
" " 2 lbs.	1.80	.148	.694	.842	
" " 3 "	2.70	.222	1.041	1.263	
" " 4 "	3.60	.296	1.388	1.684	
" " 5 "	4.50	.370	1.735	2.105	
" " 6 "	5.40	.444	2.082	2.526	
" " 7 "	6.30	.518	2.429	2.847	
" " 8 "	7.20	.592	2.776	3.368	
" " 9 "	8.10	.666	3.123	3.789	
Buckwheat middlings, 1 lb.	.87	.220	.456	.676	1:2.1
" " 2 lbs.	1.74	.440	.912	1.352	
" " 3 "	2.61	.660	1.368	2.028	
" " 4 "	3.48	.880	1.824	2.704	
" " 5 "	4.35	1.100	2.280	3.380	
" " 6 "	5.22	1.320	2.736	4.056	
" " 7 "	6.09	1.540	3.192	4.732	
" " 8 "	6.96	1.760	3.648	5.408	
" " 9 "	7.83	1.980	4.104	6.084	
By-products—					
Malt-sprouts, 1 lb.	.90	.186	.409	.595	1:2.2
" 2 lbs.	1.80	.372	.818	1.190	
" 3 "	2.70	.558	1.227	1.785	
" 4 "	3.60	.744	1.636	2.380	
" 5 "	4.50	.930	2.045	2.975	
" 6 "	5.40	1.116	2.454	3.570	
" 7 "	6.30	1.302	2.863	4.165	
" 8 "	7.20	1.488	3.273	4.760	
" 9 "	8.10	1.674	3.681	5.355	
Brewers' grains, wet, 1 lb.	.24	.039	.125	.164	1:3.2
" " " 2 lbs.	.48	.078	.250	.328	
" " " 3 "	.72	.117	.375	.492	
" " " 4 "	.96	.156	.500	.656	
" " " 5 "	1.20	.195	.625	.820	
" " " 6 "	1.44	.234	.750	.984	
" " " 7 "	1.68	.273	.875	1.148	
" " " 8 "	1.92	.312	1.000	1.312	
" " " 9 "	2.16	.351	1.125	1.476	
" " " 11 "	2.64	.429	1.375	1.804	
" " " 12 "	2.88	.468	1.500	1.968	
" " " 15 "	3.60	.585	1.875	2.460	
Brewers' grains, dry, 1 lb.	.92	.157	.478	.635	1:3
" " " 2 lbs.	1.84	.314	.956	1.270	
" " " 3 "	2.76	.471	1.434	1.905	
" " " 4 "	3.68	.628	1.912	2.540	
" " " 5 "	4.60	.785	2.390	3.175	

TABLE II.—DIGESTIBLE NUTRIENTS IN THE STATED AMOUNTS OF THE MORE COMMON FEEDING-STUFFS, continued.

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients			Nutritive ratio
		Protein	Carbohydrates + (fat×2.25)	Total	
By-products, continued—					
Brewers' grains, dry, 6 lbs.	5.52	.942	2.868	3.810	
" " " 7 "	6.44	1.099	3.346	4.445	
" " " 8 "	7.36	1.256	3.824	5.080	
" " " 9 "	8.28	1.413	4.302	5.715	
Buffalo gluten feed, 1 lb.	.90	.232	.699	.931	1:3
" " " 2 lbs.	1.80	.464	1.398	1.862	
" " " 3 "	2.70	.696	2.097	2.793	
" " " 4 "	3.60	.928	2.796	3.724	
" " " 5 "	4.50	1.160	3.495	4.655	
" " " 6 "	5.40	1.392	4.194	5.586	
" " " 7 "	6.30	1.624	4.893	6.517	
" " " 8 "	7.20	1.856	5.592	7.448	
Chicago gluten meal, 1 lb.	.88	.322	.468	.790	1:1.5
" " " 2 lbs.	1.76	.644	.936	1.580	
" " " 3 "	2.64	.966	1.404	2.370	
" " " 4 "	3.52	1.288	1.872	3.160	
" " " 5 "	4.40	1.610	2.340	3.950	
" " " 6 "	5.28	1.932	2.808	4.740	
" " " 7 "	6.16	2.254	3.276	5.530	
" " " 8 "	7.04	2.576	3.744	6.320	
Distillers' dried grains,					
Bile's xxxx, 1 lb.	.92	.248	.552	.800	1:2.2
" 2 lbs.	1.84	.496	1.104	1.600	
" 3 "	2.76	.744	1.656	2.400	
" 4 "	3.68	.992	2.208	3.200	
" 5 "	4.60	1.240	2.760	4.000	
" 6 "	5.52	1.488	3.312	4.800	
" 7 "	6.44	1.736	3.864	5.600	
" 8 "	7.36	1.984	4.416	6.400	
Hominy chops, 1 lb.	.89	.075	.705	.780	1:9.4
" " 2 lbs.	1.78	.150	1.410	1.560	
" " 3 "	2.67	.225	2.115	2.340	
" " 4 "	3.56	.300	2.820	3.120	
" " 5 "	4.45	.375	3.525	3.900	
" " 6 "	5.34	.450	4.230	4.680	
" " 7 "	6.23	.525	4.935	5.460	
" " 8 "	7.12	.600	5.640	6.240	
" " 9 "	8.01	.675	6.345	7.020	
Linseed meal (old process), 1 lb.	.91	.293	.485	.778	1:1.7
" " " 2 lbs.	1.82	.586	.970	1.556	
" " " 3 "	2.73	.879	1.455	2.334	
" " " 4 "	3.64	1.172	1.940	3.112	
" " " 5 "	4.55	1.465	2.425	3.890	
" " " 6 "	5.46	1.758	2.910	4.668	
" " " 7 "	6.37	2.051	3.395	5.446	
Linseed meal (new process), 1 lb.	.90	.282	.464	.746	1:1.6
" " " 2 lbs.	1.80	.564	.928	1.492	
" " " 3 "	2.70	.846	1.392	2.238	
" " " 4 "	3.60	1.128	1.856	2.984	
" " " 5 "	4.50	1.410	2.320	3.730	
" " " 6 "	5.40	1.692	2.784	4.476	
" " " 7 "	6.30	1.974	3.248	5.232	
Cottonseed meal, 1 lb.	.92	.372	.444	.816	1:1.2
" " 2 lbs.	1.84	.744	.888	1.632	
" " 3 "	2.76	1.116	1.332	2.448	
" " 4 "	3.68	1.488	1.776	3.264	
" " 5 "	4.60	1.860	2.220	4.080	

Table II.—Digestible Nutrients in the Stated Amounts of the More Common Feeding-stuffs, continued.

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients			Nutritive ratio
		Protein	Carbohydrates+ (fat×2.25)	Total	
By-products, continued—					
Cottonseed meal, 6 lbs.	5.52	2.232	2.664	4.896	
“ “ 7 “	6.44	2.604	3.008	5.712	
“ “ 8 “	7.36	2.976	3.552	6.528	
“ “ 9 “	8.28	3.348	3.996	7.344	
Miscellaneous—					
Cabbage, 1 lb.	.15	.018	.091	.109	1:5.1
“ 5 lbs.	.75	.090	.445	.545	
“ 15 “	2.25	.270	1 365	1.635	
“ 20 “	3.00	.360	1.820	2 180	
“ 25 “	3.75	.450	2 275	2 725	
“ 30 “	4.50	.540	2.730	3 270	
“ 35 “	5.25	.630	3.185	3 815	
“ 40 “	6 00	.720	3.640	4.360	
Sugar-beet leaves, 1 lb.	.12	.017	.051	.068	1:3
“ “ 5 lbs.	.60	.085	.255	.340	
“ “ 15 “	1.80	.255	.765	1.020	
“ “ 20 “	2.40	.340	1.020	1.360	
“ “ 25 “	3.00	.425	1.275	1.700	
“ “ 30 “	3 60	.510	1.530	2 040	
“ “ 35 “	4.20	.595	1 785	2 380	
“ “ 40 “	4 80	.680	2 040	2.720	
Pea-vine silage, 1 lb.	.27	.025	.141	.166	1:5.6
“ “ 5 lbs.	1.35	.125	.705	.830	
“ “ 15 “	4.05	.375	2.115	2.490	
“ “ 20 “	5.40	.500	2.820	3.320	
“ “ 25 “	6.75	.625	3.525	4.150	
“ “ 30 “	8.10	.750	4.230	4.980	
“ “ 35 “	9.45	.875	4.935	5.810	
“ “ 40 “	10.80	.900	5.640	6.640	
Sugar-beet pulp, 1 lb.	.10	.006	.073	079	1:12
“ “ 5 lbs.	.50	.030	.365	395	
“ “ 15 “	1.50	.090	1.095	1.185	
“ “ 20 “	2.00	.120	1 160	1.580	
“ “ 25 “	2 50	.150	1.825	1.975	
“ “ 30 “	3 00	.180	2.190	2.370	
“ “ 35 “	3.50	.210	2.555	2.765	
“ “ 40 “	4.00	.240	2 920	2.160	
Beet molasses, 1 lb.	.79	.091	.595	.686	1:6.5
“ “ 2 lbs.	1.58	.182	1.190	1.372	
“ “ 3 “	2 37	273	1 785	2.058	
“ “ 4 “	3.16	.364	2.380	2.744	
“ “ 5 “	3.95	.455	2.975	2.430	
“ “ 6 “	4.74	.546	3.570	4.116	
“ “ 7 “	5.53	.637	4.165	4.802	
“ “ 8 “	6.32	.728	4.760	5.488	
“ “ 9 “	7.11	.819	5.355	6.174	
Apple pomace, 1 lb.	.233	.011	.164	.175	1:14.9
“ “ 5 lbs.	1.165	.055	.820	.875	
“ “ 15 “	3.495	.165	2.460	2.625	
“ “ 20 “	4.660	.220	3.280	3.500	
“ “ 25 “	5.825	.275	4.100	4.375	
“ “ 30 “	6.990	.330	4.920	5.250	
“ “ 35 “	8.155	.385	5.740	6.125	
“ “ 40 “	9.320	.440	6.560	7.000	
Apples, 1 lb.	.19	.007	.188	.195	1:26.8
“ 5 lbs.	.95	.035	.940	.975	
“ 15 “	2.85	.105	2.820	2.925	

TABLE II.—DIGESTIBLE NUTRIENTS IN THE STATED AMOUNTS OF THE MORE COMMON FEEDING-STUFFS, continued

Kind and amount of feed	Total dry matter	Pounds of digestible nutrients			Nutritive ratio
		Protein	Carbohydrates+ (fat×2.25)	Total	
Miscellaneous, concluded—					
Apples, 20 lbs.	3.90	.140	3.760	3.900	
" 25 "	4.75	.175	4.700	4.875	
" 30 "	5.70	.210	5.640	5.850	
Skim-milk, centrifugal, 1 lb.	.094	.029	.059	.088	1:2
" " 5 lbs.	.470	.145	.295	.440	
" " 8 "	.752	.232	.472	.704	
" " 12 "	1.128	.348	.708	1.056	
" " 15 "	1.410	.435	.885	1.320	
" " 20 "	1.880	.580	1.180	1.760	
" " 25 "	2.350	.725	1.476	2.200	
" " 30 "	2.820	.870	1.770	2.620	
Buttermilk, 1 lb.	.10	.039	.065	.104	1:1.7
" 5 lbs.	.50	.195	.325	.520	
" 8 "	.80	.312	.520	.832	
" 12 "	1.20	.468	.780	1.248	
" 15 "	1.50	.585	.975	1.560	
" 20 "	2.00	.780	1.300	2.080	
" 25 "	2.50	.975	1.625	2.600	
" 30 "	3.00	1.170	1.950	3.120	

To illustrate how these tables may be used, we will examine a system of feeding which the writer observed recently in a certain section of New York, and which he was told is extensively practiced. The section referred to is devoted almost exclusively to dairying, and timothy hay constitutes the greater part of the coarse fodder during the feeding season. Oats are about the only grain grown. Corn is purchased and ground with the oats, in about equal weights, to make "chop" which is fed with the hay. The cows will not vary greatly from 1,000 pounds live weight. While these cows are in full flow of milk in the spring before the pasture is ready, they are fed about twenty pounds of hay and eight pounds of chop per day. Turning to the tables, we find that twenty pounds of hay, four pounds of oats, and four pounds of corn contain digestible nutrients as follows:

	Dry matter	Protein	C H. and fat	Total	Nutritive ratio
20 lbs. hay	17.40	.560	9.300	9.860	. . .
4 lbs. oats	3.56	.368	2.772	2.640	. . .
4 lbs. corn	3.56	.316	3.056	3.372	. . .
Total	24.52	1.244	14.628	15.872	1:11.7
Wolff's standard	24.00	2.5	13.4	15.9	1: 5.4

On comparison of the nutrients furnished by this ration with Wolff's standard as given in Table I, it is discovered that while the dry matter and total nutrients are not far out of the way, the protein is much too small, the carbohydrates and fat are somewhat too great, while the nutritive ratio is far too wide. This result might readily have been foreseen had we paused a moment to note the nutritive ratio of each of the three foods entering into the ration. They are: timothy hay, 1:16.6; oats, 1:6.2; corn, 1:9.7. Neither of them is as narrow as the standard, and it is impossible to combine them into a ration that is approximately balanced. Just here is where farmers frequently fail to get best results in feeding. The fact that they are feeding some concentrates (in this case corn and oats) along with the hay misleads them into thinking that the cows are getting a proper ration; and if the cows lay on fat under this carbonaceous diet they are the further misled, when, as a matter of fact, maximum production is not being secured.

In this case, as corn is a purchased product, the natural suggestion is that the corn should be replaced by some food having a high proportion of protein, or, in other words, a very narrow nutritive ratio. Consulting the table, it is found that among such are linseed meal, cottonseed meal, gluten feed, malt-sprouts, buckwheat middlings, and others. As buckwheat middlings is a New York state product, and can readily be put in stock during the winter, it is suggested to substitute it for the corn in the ration. Again taking the figures from the table, and substituting buckwheat middlings for corn, we have:

	Dry matter	Protein	C. H. and fat	Total
20 lbs. timothy hay	17.40	.560	9.300	9.860
4 lbs. oats	3.56	.368	2.272	2.640
4 lbs. buckwheat middlings	3.48	.880	1.824	2.704
Total	24.44	1.808	13.396	15.204

Nutritive ratio 1:7.4

While this ration is much improved over the previous one, and will produce a more abundant flow of milk, it is still too wide to produce the best results.

If the timothy hay is reduced two pounds, and two pounds of cottonseed meal put in its place, we get:

	Dry matter	Protein	C. H. and fat	Total
18 lbs. timothy hay	15.66	.504	8.370	8.874
4 lbs. oats	3.56	.368	2.272	2.640
4 lbs. buckwheat middlings	3.48	.880	1.824	2.704
2 lbs. cottonseed meal	1.84	.744	.888	1.632
Total	24.54	2.496	13.354	15.850

Nutritive ratio 1:5.3

This ration corresponds very closely to the standard, and while the purchase of the cottonseed meal will add something to the expense, still it is the experience of careful feeders that the increased production will pay abundantly for thus securing a proper balance to the ration. The same result may be obtained by using other feeding-stuffs having a narrow nutritive ratio.

The question is likely to be raised, which of the various feeding-stuffs offered in the market may be used most economically in supplementing the home-grown foods to produce a balanced ration? This question is best answered by formulating properly balanced rations containing each of the foods under consideration, and by assigning the actual market value per pound to each of the constituents of the ration, its cost is readily ascertained, and the cheapest may be selected.

Supplementing pasture with a balanced ration.

Often it is necessary or desirable to supplement the food received by animals while running on pasture. Two somewhat different cases may arise. First, when the pasturage is fairly abundant but it is desired to force production to the highest possible point. Since the herbage cropped from pastures usually is approximately balanced, in this case the supplementary food may consist of concentrates so combined as in themselves to have about the nutritive ration that would be appropriate for the entire ration. Second, when the herbage is markedly deficient in amount and probably in succulence also. In this case it is desirable to provide some bulky food as well as some concentrates. These should be selected with reference to one another so as in themselves to be fairly well balanced. If green corn is used a more proteinaceous concentrate is needed than if green clover or alfalfa is used.

Literature.

This article is adapted from Bulletin No. 154, Cornell University Agricultural Experiment Station, prepared by the writer.

STOCK-POISONING

By *N. S. Mayo*

Malicious poisoning of domestic animals, with the exception of dogs and cats, is very rare, but accidental poisoning of farm stock is not infrequent. When a number of animals die without symptoms of disease, accidental poisoning is to be suspected, and a careful examination of the food, water, and surrounding conditions should be made, to determine the cause. A number of methods of poisoning must be considered. Throughout the western range country probably the commonest source is the eating of poisonous weeds by the stock. This phase of the subject is discussed separately in the succeeding article by Wilcox.

Chemical-poisoning.

Farm animals are sometimes poisoned by solutions used for spraying plants or by lead paints, and sometimes by nitrate of soda which cattle secure by chewing old fertilizer sacks. Sheep are sometimes poisoned by eating excessive quantities of common salt when not accustomed to it. In arid regions, stock may be poisoned by drinking alkali water. City garbage, sometimes used as food for poultry and swine, frequently contains poisonous substances, particularly excessive quantities of soap, or soap powders in solution.

When animals are poisoned by chemical substances, there is usually severe abdominal pain and irritation of the bowels. As most farm animals can not vomit, it is advisable to give doses of raw linseed or castor-oil, followed by linseed-meal gruels, with a little fresh milk containing the beaten whites of eggs.

Forage-poisoning.

Conditions of the plants and animals play an important part in forage-poisoning. Some plants are poisonous only in certain stages of their growth, and it is certain that climatic conditions, by checking the growth of plants, may cause the formation or deposition within the tissues of the plant of toxic substances that are not present in appreciable quantities under normal conditions.

If an animal is thin in flesh, or hungry, poisonous substances will affect it more seriously, while the presence of other foods in the digestive organs sometimes tends to modify the effect of the poisons. In some cases, the presence of a considerable amount of undigested food in the digestive organs seems to cause a paralysis of the digestive functions to such an extent that decomposition of the contents of the digestive organs follows, and poisonous substances may be produced and cause death.

More frequently farm animals suffer from forage-poisoning from eating either moldy or decomposing foods, or plants that contain poisonous substances. Any decomposing or moldy food may be poisonous for stock, moldy silage, grain and hay particularly. Heavy losses of horses occur in some years in the middle West from inflammation of the brain (Cerebritis) or its coverings (Meningitis), commonly called "mad staggers." This disease is caused by eating corn that has been injured by the green corn-worm and attacked by a mold. Lowland hay that contains mold or other fungi may cause death, and hay that has been flooded may contain sand or other irritating materials that cause serious purging of animals.

Corn-stalk disease.—When stalk-fields are pastured by cattle after the corn is harvested, frequent and heavy losses sometimes occur from what is called "corn-stalk disease." This disease seems to be a combination of acute indigestion and poisoning. It occurs most frequently when cattle are first turned into a field or changed from one field to another. The disease appears suddenly. The animal shows symptoms of abdominal pain, followed by delirium and death usually within twenty-four hours. Medical treatment is of little value.

The preventive is to give the cattle access to some laxative food, such as green rye, alfalfa or alfalfa hay, to give plenty of water and small quantities of salt frequently, and never to turn the stock into the stalk-fields hungry.

Sorghum-poisoning.—Sorghum, and particularly second-growth sorghum, may contain, under conditions that are not entirely understood, sufficient prussic acid to kill cattle quickly when they pasture on it. The animals usually die so quickly that little can be done. If possible, give, as a drench, sixty to eighty grains of permanganate of potash dissolved in a quart of water. [See Vol. II, page 581, for fuller notes.]

Cottonseed meal.

Cottonseed meal is a rich, easily digested and valuable food if fed judiciously. If fed to cattle in considerable quantities for more than three months it is liable to produce symptoms of poisoning. It contains alkaloids, betain and cholin, and these or others seem to have a cumulative effect. There is a peculiar vacant stare, impaired vision and twitching or trembling of the voluntary muscles. As soon as the symptoms are noticed, the cottonseed meal should be withheld.

Swine are more easily poisoned by cottonseed meal than cattle. The symptoms are drowsiness, labored breathing, feeble heart-action when exercised, congestion of the lungs and irritation of the bowels. Swine following cattle that are full-fed on cottonseed meal may get sufficient to cause poisoning. The amount required to affect animals varies with the amount and kind of other foods that they receive. Six pounds of cottonseed daily to cattle on full feed is nearly the limit, and even this may be injurious.

Poisonous Weeds and Their Eradication

By *E. V. Wilcox*

The problems connected with plant-poisoning of stock have been brought to the farmers' attention in parts of the country by the loss of stock as a result of feeding these weeds. The variety and number of poisonous weeds are much greater in the western states than in the more thickly settled parts of the East. This obviously is due to the fact that in the eastern states land is more valuable and is more systematically cultivated. There is, therefore, a smaller proportion of native pasture land. Pastures are plowed from time to time, cultivated to various crops, and allowed to run to pasture again. As a result, the forage found in such pastures belongs to cultivated species of grasses and contains comparatively few weeds of a poisonous nature.

Fig. 104. Death camas (*Zygadenus venenosus*).

In the western states, however, particularly in the range country, many wild species of poisonous plants are found and, for the most part, are enabled to persist for the reason that no cultivation is attempted on range lands. In favorable seasons, the amount of grass and other valuable forage plants on range land is sufficient for the maintenance of stock. In seasons of short grass, however, the amount of wholesome forage may be insufficient for the stock which grazes on range land, and the stock, therefore, may be forced by hunger to eat unpalatable or poisonous weeds that they otherwise would not touch. The extent of plant-poisoning, therefore, is an indication of the condition of the range. In the earlier days when the range was not so badly overstocked, cases of poisoning were of much less frequent occurrence. With the over-crowding of the range, however, and consequent destruction of

the grass, plant-poisoning has become a more serious problem.

Death camas. (Fig 104.)

Among the important poisonous plants of the western states, death camas (*Zygadenus venenosus*) occupies a prominent place. This plant is distributed from British Columbia to Nebraska and westward to California. It is known by various common names, such as crowfoot, lobelia and wild onion, in various parts of the country. It grows at altitudes from 1,500 to 8,000 feet. It is a smooth, single-stemmed, perennial plant with onion-like bulb, narrow leaves which appear early in the spring, spreading apart in such a manner as to suggest the name crowfoot. The leaves are somewhat more succulent than grass and appear before most grasses have started in the spring. The plant therefore appears tempting and is frequently eaten, especially by sheep, with serious consequences. Throughout the western states losses are reported from eating this plant. In general, about 20 per cent of the cases appear to be fatal. The bulb is also poisonous to man. The symptoms of poisoning are uneasiness and irregularity in movement, accompanied soon by spasms and rapid breathing. Later the animals show almost complete paralysis and lie on their side with rapid respiration and frequent irregular pulse. In some cases death results within one or two hours, while in others the animal may lie on the side one to two days.

The best means of counteracting the poisonous effects of this plant have been found in the use of permanganate of potash. As a drench, for sheep about five to ten grains, for horses fifteen to twenty grains, and for cattle thirty to fifty grains, are suitable doses. The permanganate of potash can be combined with an equal amount of sulfate of aluminum, and both should be dissolved before being administered. This antidote is not a physiological one but depends for its efficiency on a chemical action. Permanganate of potash is an active oxydizer and readily renders harmless poisonous substances with which it comes in contact in the stomach. They are thereby prevented being absorbed in a poisonous condition. If the symptoms of poisoning are observed soon enough the animal may be saved in most cases by this remedy, and, since its action is chemical and not specifically physiological, it is obviously indicated as a remedy in the case of poisoning by other plants.

Larkspur and aconite. (Fig. 105.)

Another important group of plants that cause poisoning of live-stock includes the larkspurs and aconite. Some of the larkspurs are commonly called aconite by stockmen. Many of the species of larkspur have been shown to be poisonous, particularly *Delphinium bicolor* and *D. glaucum.* The symptoms of poisoning from larkspur are a rapid respiration and pulse, slight lowering of the body temperature, profuse sweating, and occasional bloat. The western species of aconite (*Aconitum Columbianum*) is not the same as the one that is commonly used in the preparation of the well-known drug, but it has been shown to contain poison in the leaves, stems, and roots.

The antidotes that have proved successful in the treatment of such cases of poisoning are permanganate of potash, as mentioned for death camas poisoning, and physiological antidotes to counteract the effect of larkspur. These include atropin in doses of one-sixth to one-third grain, depending on the size of the sheep, and in corresponding doses in

Fig. 105. Purple larkspur, young plant (*Delphinium bicolor*).

larger animals. Atropin is a heart stimulant and exercises an immediate effect in counteracting the influence of the alkaloid of larkspur on the heart and respiration. In mild cases of poisoning by larkspur, the administration of a tablespoonful of ammonia, or a half-cupful of alcohol in water may give good results. The use of ammonia fumes in the nostrils is sometimes successful. Atropin should be administered in a solution of water as a hypodermic injection.

Water hemlock. (Fig. 167, Vol. II).

In the western range country, along moist places and waterways, various species of water hemlock are found, which are extremely poisonous in nearly all stages of growth. One of the most common species is *Cicuta occidentalis.* This is a smooth perennial, two to five feet high, with long, fleshy roots, large-branched leaves, and flat-topped clusters of greenish white flowers. It is commonly known among stockmen as wild parsnip. This plant has been shown to be very poisonous to sheep, cattle, and other domestic animals, as well as to man. The symptoms of poisoning are evidences of acute pain, frenzy, muscular spasms, irregular respiration, and a hard pulse. In some cases death takes place within fifteen minutes, and nearly always the symptoms are more violent than in other cases of plant-poisoning. As a rule, the symptoms develop so rapidly that permanganate of potash can not be used. Occasionally the administration of morphine or chloral hydrate gives relief, but these drugs can not be depended on.

Loco-weed (Fig. 106).

Since the earliest days of the range business the loco-weed has been referred to as the cause of the so-called loco condition in animals. Many attempts have been made to determine the poisonous principle which may be found in these plants, but without success. In Colorado it was supposed that loco acid was found in the common species of loco-weed of that state, but this has not been substantiated. In Colorado and Kansas the most common species of loco-weed is *Astragalus mollissimus*, while in Montana the name is usually applied to species of Aragallus, especially *A. spicatus*. Nearly all stockmen of the western range have had experience with loco, and in some cases the raising of horses, sheep and cattle on certain tracts of range has been abandoned because of the persistence of this trouble. Notwithstanding the numerous investigations that have been made, however, the exact cause of the trouble still appears doubtful. Several diseases have been referred to by this name. In some instances, cases of gid in sheep have been called loco, in others a condition of anemia and malnutrition due to scarcity of forage is the cause of the trouble. Stomach worms and the common tapeworm of the sheep have also been supposed to cause loco disease. It is impossible, however, for this to be the main cause of loco, since stomach-worms are comparatively rare in the region where loco most prevails, and very abundant in the eastern states where loco is unknown. It still appears to be probable that

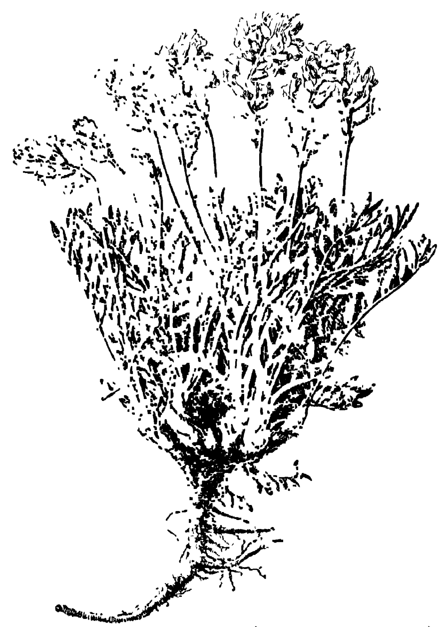


Fig. 106. White loco-weed (*Aragallus spicatus*).

some of the cases referred to as loco disease are due to eating the plants referred to above.

No direct antidote or medicinal treatment has been worked out for this trouble. Numerous stockmen, however, have found that by confining the stock in corrals, preventing their feeding on loco-weeds, and giving them plenty of nutritious forage, such as alfalfa, grains, and root crops, the symptoms of loco disappear and the animals may again become useful. In the case of horses, the affected animal may become apparently normal, but he is not strictly reliable and may show fright from time to time without apparent cause. In the case of sheep, however, the conditions are different, since these animals are not considered so good for breeding purposes after having once become locoed. They are therefore fattened as soon as possible and sold for mutton. No injurious properties attach to mutton of locoed sheep.

Cockle-bur.

The common cockle-bur (*Xanthium Canadense*), when very young and in the two-leaved stage of its growth, may be very poisonous for swine and sometimes for cattle. The animals seem greatly depressed and die quickly. The treatment is to give permanganate of potash followed by stimulants.

Fig. 107.
Poison lupine (*Lupinus leucophyllus*).

Miscellaneous poisonous plants.

Among the numerous other poisonous plants of less importance, mention should be made of lupines (Fig. 107), ergot, swamp camas, milk-weed, corn flower, nightshades, sneeze-weed, dogbane, bane-berry, laurels, and wild cherry (Fig. 108). Hay containing the common horsetail (*Equisetum arvense*) sometimes causes poisoning of horses.

Protective measures.

An important point to consider in connection with poisonous plants is that the poisonous principles are not always present but may appear only at one stage of growth, and be absent at all other stages, or may be strictly localized in only one part of the plant, as for example in the root or seeds. This is strikingly the case in lupines, which are used extensively for grazing and for hay and which, under ordinary circumstances, are exceedingly valuable for this purpose. At times, however, the poisonous principle appears particularly in the ripe seed and causes extensive losses, especially among sheep. In a few instances, 1,500 to 2,000 sheep have been killed thus within a few hours. The farmer should bear in mind, therefore, that a plant is not shown to be harmless by feeding in one stage without bad results. Many sheepmen have learned this fact by sad experience.

In order to prevent serious results from poisonous plants, it is desirable to improve the grazing conditions for stock so that animals will not be forced to eat the poisonous plants. If such plants

are studied by the ranchmen and farmers it will be observed that they have different habitats and may be expected to occur under these conditions. It is possible, therefore, in many instances to eradicate a poisonous plant from a given range with little expense, since it may occur only in a few restricted localities. When such eradication is impossible, because of the general distribution of the plant, poisoning from this source may be avoided by dividing the range so as to keep the stock away from the poisonous areas during the season of the year when the plant is poisonous. By this system it is unnecessary to lose the use of any part of the range, and the ranchman is insured against losses from plant-poisoning. Certain stockmen, particularly in the range states, have found that animals are especially likely to eat poisonous plants along streams and marshy places. In such localities the poisonous plants may be eradicated by digging, or the danger may be greatly lessened by sowing grass seed so as to improve the quality of the forage in these places, thus minimizing the prominence and importance of the undesirable weeds.

Fig. 108. Western wild cherry (*Prunus demissa*). A stock-poisoning shrub.

Literature.

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CHAPTER V

DISEASES AND MANAGEMENT OF ANIMALS

By JAMES LAW

DISEASES LARGELY DETERMINE the character and the profitableness of live-stock interests. These diseases are the special field of study of the veterinarian. The value of veterinary medicine to the United States may be inferred from the number of farm quadrupeds—over 200,000,000,—worth four and a half billions of dollars, and subject to all kinds of accidents and sporadic diseases. The saving of but one-half of one per cent of this stock would mean a yearly revenue of some twenty millions of dollars and could easily strike the balance between success and failure. If we consider further that the fertility of our soil depends in the final count on the number of live-stock and the quantity of their products that can be used as fertilizer, we enhance the value of any great increase in our flocks and herds almost beyond computation.

A successful live-stock industry, and the soil fertility which comes from a dense aggregation of animals, depend far more on the prevention and exclusion of communicable diseases, than on the skilful dealing with the common every-day affections which are not transmissible. Formerly rinderpest ravaged Europe at frequent intervals, as soon as the few recovered and immune animals had been

replaced by susceptible ones. In the eighteenth century, rinderpest alone cost Europe 20,000,000 head of cattle worth $1,000,000,000. From 1843 to 1892 lung plague cost the United States, on exports alone, $2,000,000 per annum. Foot-and-mouth disease, wherever it penetrated, paralyzed the dairy industry, and, attacking all bisulcates and many other warm-blooded animals, caused incalculable losses.

The two diseases—lung-plague and foot-and-mouth disease—are the only two animal plagues that, in America, have been placed in the hands of accomplished veterinary sanitarians with plenary power to extirpate them, and each has been exterminated and banished from the continent. This safeguarding of the country from these alone abolished at once a yearly tax of many millions from which the nation had been suffering, and cut off the steadily increasing additions to this tax which would otherwise have been imposed by their inevitable progressive extension.

Our remaining animal plagues present other problems in sanitary economy, but they are allowed to prevail and extend with no such effective control as gives promise of their extinction. At least three different febrile plagues of swine carry off tens of millions of dollars yearly; contagious abortion of cows is now almost coextensive with the dairy interest, and in place of intelligent sanitary control is made the occasion of the widespread sale of empirical nostrums which claim to prevent a repetition of abortion by the same animal, a work which unaided nature accomplishes. Contagious abortion can be in most cases exterminated, but this entails the most stringent measures against any transfer from a herd in which the disease exists or has existed. With this enforced, preventive treatment can be made successful in destroying the germ and eradicating the disease. But with free sales, and a disease progressing unseen for six or eight months, without manifest symptoms, in what appears to be a perfectly healthy animal, it will continue to be propagated with disastrous result.

Texas fever has long dwarfed the cattle industry of the South. The coast states from Virginia to Texas, if stocked like Illinois, could easily sustain 40,000,000 head worth $1,500,000,000. The southern cattle industry is awaking to the truth that the systematic extermination of the cattle tick, the bearer of the germ, would be a most remunerative investment.

The common shipping fevers of dealers' horses, strangles, influenza and contagious pneumonia, cause untold losses to the country every year, and it is a very risky speculation to buy a young horse that has just run the gauntlet of railway cars, feeding-stables, stock-yards and sale-stables. As in the case of other plagues, these could all be done away with under a system which required an official guarantee of the absence of infection from the district from which the shipment takes place; the obligation of the carrying companies to carry no solipeds without this evidence, and to have all cars and stables thoroughly disinfected after each shipment; also the obligation on dealers to admit only such guaranteed horses, and instantly to quarantine all sick horses, and such as have been exposed to them.

At present, tuberculosis occupies the public mind more than any other contagious disease of animals. Its extension has been almost phenomenal in spite of the ineffective measures taken for its control. The great extension of the dairy industry has led to the demand for a herd in full milk all through the year. Failing cows are sold and replaced by fresh ones, and in many cases the whole herd is changed in the course of a year. Every such purchase is in the nature of a gamble, with the added risk that the former owner is anxious to get rid of his unthrifty or unhealthy cows, rather than the sound and thrifty. Some states have been especially unhappy in their trade in dairy cows. Adjacent states have refused dairy cows from outside sources, unless they have just successfully passed through the tuberculin test. Thus the sound cows have been selected out of the herds in the unprotected region, leaving the diseased ones huddled together in a concentrated infection. Under such a condition, tuberculosis makes more rapid progress. The latter state, on its part, may have required no tuberculin test, so that stock-owners in adjacent states could ship into it the still healthy-looking cows that had failed to pass the tuberculin test, thereby making tuberculosis still more concentrated. Again, shipments of cows into a large market, were there tested, and the healthy sent into adjoining states, with a certificate of soundness, while the tuberculous were left to be sold. As an illustration of the extent to which tuberculosis may spread, it may be stated that in fifteen years the percentage of cows found to be tuberculous in testing dairy herds in New York, rose from 11.6 per cent in 1892 to 36 per cent in 1904–7, in the herds that were tested.

Aside from infectious diseases, there are endless varieties of animal parasitism, and an accurate knowledge of the habits of each species is imperative. Every stock-owner should secure this knowledge, while practicing veterinarians and veterinary sanitary officers, who have failed to master it, are themselves injurious parasites on the body politic.

INFECTIOUS DISEASES OF ANIMALS

By *Veranus A. Moore*

The term "disease" is employed to indicate the existence of disturbances of the physiological activity of the organs. It is a deviation from the healthy or normal anatomical and chemical relations of the body constituents. Diseases, therefore, are processes which are due to natural causes. The causes which disturb the normal conditions of the animal body are numerous but they may be summarized under the following headings: (1) Disturbances of nutrition, depending on improper kinds or quantities of food. (2) Lack of oxygen, resulting from poor ventilation or obstruction to respiration. (3) Functional disturbances, due to over-exercise or work, or to a lack of the necessary amount of body activity. (4) Thermic influences, depending on too high or too low temperatures. (5) Electric agencies. (6) Mechanical injuries. (7) Poisons. (8) Infection. (9) Animal parasites. The diseased conditions produced in the animal body by malnutrition, over-work, poor hygiene and the injurious effects of electricity and thermal disturbances are known as general diseases; those due to parasites are called parasitisms, and those caused by microörganisms are known as infectious diseases. The diseased conditions due to infection are known under two headings, namely, wound infection and specific infectious diseases.

Infection.

The term infection has come to be understood to mean the entrance into the animal body, from without, of living microörganisms, capable of multiplying within the living tissues and of producing, in consequence thereof, a local or a general diseased condition; and, possibly, the death of the individual. The invading microörganisms may belong to any one of the three great groups of microscopic life, namely, bacteria, higher fungi, or protozoa.

A diseased condition produced by substances not capable of reproducing themselves, as, for example, organic or inorganic chemical compounds, is an intoxicative process, or poisoning. In an infection, the immediate cause of the symptoms and morbid changes in the tissues is an intoxication due to the action of the metabolic products (toxins) of the invading microörganisms.

If the invading organisms remain at the point of entrance and produce local tissue changes, such as inflammation or abscesses, the condition is spoken of as a wound infection. If the invading bacteria become widely distributed in the circulation and tissues, giving rise to a high temperature and other body disturbances, the condition is known as septicemia or bacterdemia. If the infecting bacteria remain at the point of entrance and multiply there, elaborating a toxin which is absorbed, and which causes symptoms and possibly death, the condition is a toxemia. If there is a febrile condition, resulting from the absorption of the products of putrefaction caused by saprophytic bacteria, the condition is called sapremia. If the invading organism is one possessed of definite pathogenic properties, such as *the bacterium of anthrax, giving rise to a definite series of symptoms and lesions, the affection is* designated a specific infectious disease.

Through the agency of metastasis, invading microörganisms may be carried from the point of introduction to other parts of the body, where they may become localized, multiply, and give rise to any one of many forms of disease. It may happen that the point of entrance is so obscure that the resulting morbid changes are not easily traced to an external infection. There are many illustrations of this, such, for example, as localized inflammations or abscesses. As already stated, for convenience in discussion infections may be divided into two clinical groups, namely, wound infections and specific infectious diseases, although in certain instances they can not be separated.

In the study of the various forms of infection in the lower animals, many lesions seem to be produced by bacteria which are harbored normally on the skin. When these organisms are introduced by accident into the living tissues they multiply and acquire (if they did not already possess it) the power to produce tissue changes. Recent investigations point to the conclusion that domesticated animals frequently suffer as a result of the invasion of bacteria at present not listed among the pathogenic organisms, and what is true in this regard for bacteria may be hypothetically applied to fungi and to the protozoa.

Channels of infection.

There are a number of ways by which microorganisms may be introduced into the living tissues of the animal body. The more common of these are as follows, namely:

(1) *Through the digestive tract.*—Bacteria gain entrance into the tissues from the digestive tract where they have been brought with the food or water. It is not clear in all cases how the invading organisms get into the tissues from the intestine. It has been demonstrated that tubercle bacteria will pass through the mucosa with fat globules in the process of digestion and absorption.

(2) *Through the respiratory tract.*—Bacteria are taken into the lungs, where they are brought with the inhaled atmosphere. Pulmonary tubercular affection is often brought about in this way.

(3) *Through abrasions of the skin or intestinal mucosa.*—The wide distribution of bacteria in nature renders it highly probable that in all wounds of the integument microörganisms will reach the fresh tissues. They may come from the cutting or tearing implement, the particles of dirt which may fall into or on the cut surface, or from the ducts of the glands of the skin itself. It may happen that the fresh tissues thus exposed are infected with one or with several species of bacteria. It may be that one or more of these species may be destroyed by the living juices of the body, or by the leucocytes, or again it is possible that, from their saprophytic nature, they may not be able to multiply in this new environment; in either case, the infection is of no significance, and

clinically would not be recognized. It may happen that only one species of the infecting bacteria multiplies and produces the morbid changes. This would be a single infection. If, however, two or more species coöperate in the production of the lesions, it is called a mixed infection. This term is also used to designate the condition when one species may be responsible for the tissue changes, although other bacteria are present but only in an accidental or passive way.

(4) *Through the generative organs.*—Infection of the reproductive organs takes place in certain instances when they are the seat of the disease. This is especially true in case of dourine.

(5) *Through the agency of insects.*—Some insects carry the virus of certain diseases from the infected and introduce it into the susceptible individuals. Thus, the mosquito carries the plasmodium of human malaria, the cattle tick the piroplasma of Texas cattle fever, and flies are often the introducers of pathogenic bacteria, such as those of anthrax. In certain instances, as with malaria, a part of the life cycle of the microörganism takes place in the body of the carrying insect.

(6) *Transmission of the virus from the parent to the fetus.*—Occasionally the young are born infected with the disease with which one or both of its parents were suffering. In these cases the specific bacteria were transmitted either from the sire at the time of coition, or later to the fetus in the uterus from the dam. It is important not to confuse these rare cases with those in which the offspring are born uninfected, but subsequently contract the disease. Many of the so-called hereditary diseases are the result of post-natal infection.

Wound infections.

Many diseased conditions of animals result from the local effects of bacteria or fungi getting into the tissues through cuts or abrasions of the skin. These usually appear as acute or chronic inflammations, with or without suppurations. In wound infection, the invading organism is not always of the same species. It is because of the fact that wound infection lesions may be caused by a number of different bacteria that they cannot be classed among the specific infectious diseases. It is observed further, that in many of these lesions two or more species have been responsible for the results. There is no symptom or manifestation of tissue changes by which one can determine the specificity of the exciting cause. If this is done it requires a bacteriological examination. A large number of species of bacteria and a few fungi are included among the organisms which are known to produce wound infections in animals. Fungi and protozoa are rarely found in acute wound infection. Many of the specific pathogenic bacteria may be introduced through wounds. In addition to the usual disorders following wound infection, there are many lesions that develop in the animal body, which are the direct result of bacterial invasion. These are known by various names.

(1) *Botryomycosis.*—This name has been given to a variety of lesions found more commonly on the horse but occurring also in cattle, swine and other animals. The thickened spermatic cord (scirrhous cord) which sometimes follows castration is the most common form of this disease. Practitioners often designate as botryomycosis certain closed abscesses occurring in the subcutaneous or intermuscular tissue. Abscesses and nodules found in the internal organs have also been included under this caption. Several species of pus-producing bacteria have been isolated from these lesions. Investigations which have been made into the bacterial flora of the skin of the horse show that pyogenic bacteria are frequently present in the deeper layers of the epidermis, in ducts of glands and about the hair shafts. With the possibility of infection from the integument in addition to all the other chances of having bacteria introduced into the body, there seems to be abundant opportunity for infection. The source of infection in the cord is to be found in the unsterilized or non-disinfected skin, improperly sterilized instruments, dressings, or the hands of the operator. The fact is worthy of note in this connection that septicemia, peritonitis, and other more distantly localized lesions occasionally follow such infections.

(2) *Infectious suppurative cellulitis.*—Cattle and sheep often suffer from inflammatory conditions of the subcutaneous tissues, especially of the lower extremities. Frequently the morbid process extends beneath the hoof, causing it to slough or to undergo resulting disintegration changes. When this condition exists, the affection is usually called "foot rot." If the inflammatory process attacks the skin also, the condition is often designated as erysipelas. If it becomes circumscribed, resulting in a local suppuration, an abscess or an ulcer is the result. The investigations which have been made concerning the cause of these lesions point to the conclusion that they result from an infection, usually with streptococci, through some slight abrasion of the skin. It frequently happens that a number of animals subjected to the same conditions are attacked at the same time, giving rise to a condition resembling an epizoötic.

(3) *Fistulous withers and poll-evil.*—These conditions, which consist of inflammation leading to suppuration of the withers and poll, are due to infection. The mechanical injuries commonly attributed as the primary cause consist usually of little more than skin irritation from ill-fitting harnesses, or saddles, or from blows. While these are mechanically not extensive, they are sufficient to liberate into the juices of the subjacent tissues the bacteria deeply seated in the integument. The inflammatory process leading to suppuration, the formation of fistulæ, the new formation of fibrous tissue in the affected parts, and even the bone necrosis occasionally seen, are all possible and rational results of the activities of the pyogenic bacteria found in the lesions.

(4) *Infectious mastitis.* (Fig. 109.)—Cattle suffer frequently from an acute inflammation of the udder as the result of bacterial invasion. It seems likely that many cases are brought about primarily by mechanical injuries, which render possible the

entrance into the fresh tissues of the bacteria of the skin or of the milk ducts. Other cases may be due to infection through the teat by bacteria capable of producing the inflammatory condition without a distinct injury to the mucous membrane. The former view that there was a sphincter muscle near the base of the teat, which closed the duct sufficiently to prevent the entrance of bacteria to the secreting parts of the gland, was not well founded on anatomical facts. The acute and more chronic inflammatory affections of the udder fall very naturally into two groups, namely, (1) those in which the parenchyma is most affected and (2) those in which the stroma or fibrous tissue is involved. The form more frequently encountered as an infectious (transmissible) disease is characterized by very marked changes in the milk, accompanied by the usual symptoms of parenchymatous inflammation of the gland itself.

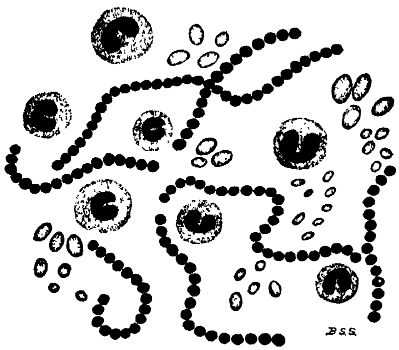

Fig. 109. Streptococci from the udder of a cow suffering from infectious mastitis, showing also pus corpuscles and fat globules.

(5) *Navel-ill or omphalophlebitis.*—This disease consists of suppurative lesions in young animals, caused by bacteria. In the horse they are most often localized in the joints of the limbs (polyarthritis). In certain other species the lesions are as likely to be situated elsewhere in the body. The infection takes place in the umbilicus. As the cord is severed in the field or stable, bacteria may gain access to the end of the exposed and freshly severed cord. In the colt, streptococci seem to be the most common species of bacteria capable of producing the joint abscesses. In lambs the colon bacillus is more frequently associated with the subcutaneous cellulitis. The prevention in these cases consists in the proper disinfection and dressing of the umbilicus at the time the cord is severed. It is the only preventive measure known.

(6) *White scours or diarrhea in calves.*—This is a disease affecting calves from a few hours to as many days old, with a mortality ranging from 50 to 90 per cent. The investigations which have been made in this country have revealed the presence of colon bacilli. Nocard reported finding other species of bacteria. He found that the calves usually die during the first week. In more chronic cases, lung lesions were found. His inquiries tend to show that this is primarily due to a wound infection. He states in his report concerning the nature of this disease that it usually lasts 3 to 6 days and is characterized by an intense intestinal discharge. The discharges are always of the nature of a diarrhea—white and frothy. The calves lose flesh rapidly, their flanks are hollow, abdomen retracted, back arched, eyes sunken, and hair dull. The lesions found at the autopsy vary. Usually the umbilicus is large and the umbilical blood vessels have indurated walls and contain blood clots which may be soft and purulent. Bloody extravasations are observed, sometimes very extensive, along the umbilical vessel and the urachus, extending sometimes to the posterior third of the bladder. White scours is ordinarily the result of umbilical infection which takes place at the time of birth by way of the wound made by the rupture of the cord. Nocard found that this trouble could be prevented if the person in charge of the animals at the time of their delivery takes precautions to prevent infection.

(7) *Miscellaneous infections.*—Attention should be called to the many morbid conditions resulting from infection that are encountered in different species of animals and are liable to be attributed to other agencies. Among these may be mentioned pericarditis, pleuritis, peritonitis, and abscess formation in different parts of the body.

[Gay, A Bacteriological Study of Fistulous Withers, Botryomycosis and Infected Wounds in the Horse, American Veterinary Review, Vol. XXIV, p. 877 (1901); Nocard, A New Pasteurellose: White Scours and Lung Diseases of Calves in Ireland, American Veterinary Review, Vol. XXV, p. 326 (1901); Ward, The Invasion of the Udder by Bacteria, Bulletin No. 178, Cornell University Agricultural Experiment Station (1900).]

Specific infectious diseases.

A specific infectious disease is the result of the multiplication within the animal body of a single species of a disease-producing microörganism. The lesions may be local or general, but the cause producing them is always the same. Thus, *Bacterium anthracis* will produce a disease which is called anthrax; no other cause will produce it, and no matter how much the lesions may vary in different individuals, if they are produced by this species of bacteria the disease is anthrax. It is clear, therefore, that there is no hard and fast line between a simple (single) wound infection and a recognized infectious or epizoötic disease, except in the nature of the invading organism. As a class the specific infectious diseases are differentiated from the lesions known clinically as wound infections in a number of ways, and there is usually a difference in the mode of infection. The virus of the epizootic disease is ordinarily introduced through the digestive or respiratory tract or by means of insects, while in wound infection the virus is introduced, as the term implies, through the injured skin or mucous membrane.

It is very important not to mistake for an infectious disease some form of body disturbance due to a local cause or condition. Animals often suffer from improper food and the conditions of life under

which they are compelled to live. It frequently happens that as all of the animals in a given herd are subjected to like conditions, a number of them, perhaps all, will manifest very similar symptoms and more or less of them die. Such an occurrence often gives rise to the supposition that the cause of death is some form of infection. Deaths from such causes or under such conditions should be carefully distinguished from an epizoötic. In differentiating a non-infectious disorder from a specific disease, it is important, and usually sufficient, to take into account the appended characteristics of an infectious disease.

(1) *Cause.*—An infectious disease is caused by a specific agent. This necessitates an exposure to and an infection with the specific organism.

(2) *Period of incubation.*—The infection must be followed by a certain period of incubation before the development of symptoms. This is the time necessary for the invading microörganism to become established in the body, and to bring about the first symptoms of the disease. The incubation period varies in different diseases, and to a certain degree in the same disease, according to the mode of infection and the resistance of the individual. Usually the incubation period of a given disease is practically the same for all individuals of the same species when subjected to the same mode of infection. Exceptions, however, are not rare.

(3) *Lesions or tissue changes.*—The morbid anatomy of an infectious disease is usually nearly the same in animals suffering in the same outbreak, especially when they were infected at or about the same time. It is more common for only a few individuals in a herd to be infected in the beginning and from these first cases for other animals to contract the disease. In many epizoötics, the disease appears in an acute form in the first animals attacked, while those infected later in the course of the outbreak suffer from a chronic form of the affection; in other outbreaks, the first cases are chronic in nature, and the later ones acute.

(4) *Duration.*—In animals, as in man, most of the infectious diseases are self-limited, but as a rule the percentage of fatal cases is much larger among animals than in the human species. The period of convalescence is not so well marked in the lower species as in man. It frequently happens that the course of the disease is so changed that an acute case, which appears to recover, or at least to pass into the stage of convalescence, becomes chronic or subchronic in nature and eventually terminates in death. The lateness in the development of the modified lesions often causes the nature of the terminal disease to go unrecognized.

(5) *Transmission by inoculation.*—Finally, it is necessary in making a positive diagnosis to find the specific organism, or to prove the transmissibility of the malady from the sick or dead to healthy animals. The extent of the spread of the virus of the disease through the available channels for its dissemination will also aid in determining the infectious or non-infectious nature of the malady in an outbreak among animals.

In diagnosing an epizoötic disease, investigations have shown that too much reliance can not be placed on the period of incubation, or the morbid anatomy. There are many possibilities, therefore, that an erroneous diagnosis may be made when the clinical and post mortem evidences of the disease are alone considered. It has also been determined that certain non-infectious disorders often assimilate, in their more general manifestations, the characters of infectious maladies. This fact necessitates much care in the differentiation of outbreaks of animal diseases. The dietary and other non-infectious disorders do not exhibit definite, uniform differential characters excepting perhaps in cases of those caused by a few mineral poisons, or by eating certain plants. As examples of these, lead-poisoning and the Pictou or Winton disease of horses and cattle caused by eating a ragwort (*Senecio Jacobæa*) may be mentioned.

The essential problem for the animal-owner in the presence of infectious diseases is to restrict the number of cases to the individuals already infected. In order to do this, it is of much importance that modified or chronic cases of any infectious disease should not escape detection if there is danger of their spreading the virus or exposing susceptible animals.

Means by which infectious diseases are spread.—It is important to consider the general ways and means by which the different vital causes of infectious diseases are spread from an infected individual to a non-infected one in the same herd and from one herd to another. As we understand them at the present time, each virus is dependent for its perpetuation on its escape from one host (sick or dead) to another. As these microörganisms are without power of their own for such migration, they are dependent on other forces and carriers to take them. In finding the means by which they spread, we must consider first how they escape from the infected individual and secondly how they are carried to another.

(1) *Escape of virus from infected individuals.*—The infecting organisms escape from the living body either with (*a*) the excreta, (*b*) the external discharge of ulcers and abscesses or both, and (*c*) the blood by sucking and possibly biting insects. After the death of the host they can escape only by the disintegration of the dead body or by its being consumed by other animals or birds. The bacteria of several diseases can pass through the digestive tract of such animals uninjured.

(2) *Dissemination of infecting organisms.*—Pathogenic bacteria are spread after they escape from the body in many ways, the following being the most common: (*a*) By direct contact; (*b*) they are carried on the hands, shoes or clothing of attendants and on farm implements, such as shovels and hoes; (*c*) they are carried in streams receiving the excreta or disintegrating bodies of the infected; (*d*) they are scattered with the excreta of birds that feed on the dead carcasses; other animals, such as dogs and foxes, are also charged with the scattering of the virus by the same method; (*e*) the virus is often carried from one herd to another by introducing chronic cases or those already infected

but before the symptoms have appeared; (*f*) animals are often infected by shipping them in cars or crates that have previously contained diseased animals and that have not been thoroughly disinfected; (*g*) the pathogenic protozoa are transferred from infected to non-infected individuals by means of insects; they are carried from place to place in infected animals.

Classification or grouping of the infectious diseases.—It will be found in the study of the morbid anatomy of the various specific maladies that the lesions in a given disease vary in different species and in individuals of the same species to a marked degree. This is dependent on several factors, especially the virulence of the virus and the resistance of the animal due to more or less natural or acquired immunity. This fact precludes the possibility of classifying or arranging them after their morbid anatomy, if the idea of a specific etiology is to be adhered to. If the infectious diseases are to be considered as parasitisms, as they appear to be, the only logical method of classifying them is the one suggested by their etiology, namely, that they shall be placed in groups corresponding to their causes. Thus, a single lesion found in the glands of the head, in the lungs, in the liver, in the mesenteric glands, in the joints, or in the generative organs, would be called tubercular if the bacteria of tuberculosis could be demonstrated to be its cause. The same conclusion would be maintained regardless of the lesion. These facts are enough to suggest that the most direct method of arranging these diseases for purposes of study is in groups composed of like generic etiological factors. Most of the known specific causes of the infectious diseases of animals are bacteria. It is necessary, therefore, in carrying out this plan to choose from among the numerous classifications of bacteria one to be followed in grouping the diseases according to the genera producing them. Of the various systems, the one by Migula (Fig. 110) seems to be the simplest and most natural, and consequently it is selected. In following this, the diseases caused by the bacteria in the different families and genera are classed together. Those due to fungi, and those resulting from protozoa are similarly grouped.

Diseases caused by streptococci.

Streptococci are the cause of many wound infections, as already stated, and certain species of them are the cause of strangles and infectious pneumonia in horses, and a specific septicemia in fowls.

Strangles.—Strangles is an infectious disease of horses, asses and their hybrids, occurring sporadically and in epizoötics. It is characterized principally by a fever, followed by an acute catarrh of the mucous membrane of the upper air-passages, especially of the nares, and a suppurative inflammation of the submaxillary and pharyngeal regions. The lesions, however, are not restricted to these parts. It is a disease of young animals. It appears to stand in equine pathology very much as measles do in human medicine,—a disease of early life, and consequently more prevalent where there are more young. It seems to exist in all countries where the horse kind are raised, and to be more prevalent in breeding districts than elsewhere. It is caused by *Streptococcus equi*, first described by Schütz, in 1888. With pure cultures of this organism Schütz was able to produce the disease in healthy horses. Its period of incubation varies from four to eight days.

The first symptom is a rise of temperature; there is loss of appetite, depression, and often great weakness. The general symptoms may continue for a few days before the localization of the lesions is apparent. The first local manifestation is usually a catarrh of the nasal mucosa, or a swelling of the submaxillary and pharyngeal lymphatic glands.

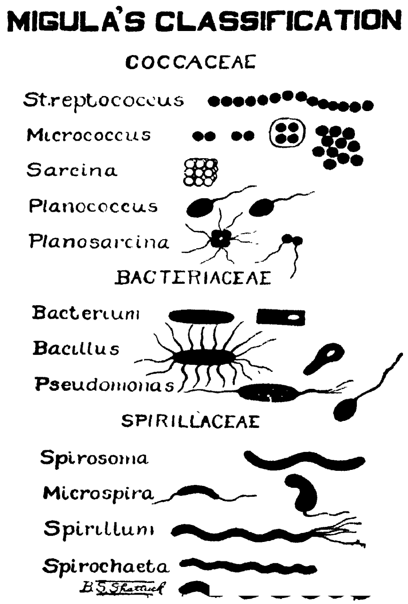

Fig. 110. Migula's classification of the lower bacteria.

The lesions in most cases are characterized by an acute inflammatory process followed by suppuration, the pus discharging either externally or into the oral cavity. Small abscesses may occur under the pharyngeal mucosa. The inflammation may extend to the superficial lymph vessels of the skin, especially of the head, resulting in the formation of a large number of small abscesses. Strangles may become chronic, especially when the nasal catarrh extends into the sinuses of the head, the guttural pouches, or pharyngeal cavity.

The duration of the disease varies according to its severity and the localization of the lesions. In mild cases convalescence begins in a few days, but in other cases restoration may require weeks and even months. The mortality, according to available statistics, does not exceed 3 per cent.

Equine contagious pleuro-pneumonia.—This disease is characterized by a high temperature, rapid pulse, but occasionally without definite lung disturbances. Like strangles, the symptoms and the lesions vary to such a degree that it is difficult to single out diagnostic features. It is widely distributed. It appears in epizoötic form, although in

certain places it is reported to be almost endemic. It prevails most extensively where large numbers of horses are congregated. It is common in the East among horses shipped from the West, when it is designated as "western" or "stable" fever. The streptococcus of Schütz seems to be the cause. However, there are opinions to the contrary based on observations. The symptoms vary to a marked degree. When pneumonia develops early in its course, the disease may appear suddenly; and in addition to the elevation of temperature, there is a cough, difficult breathing, and the pulse is increased. There is general depression, usually loss of appetite and muscular weakness; the visible mucous membranes become reddened.

The duration of the disease depends almost entirely on its course; in the more typical cases the fever lasts five to eight days. The period of convalescence is two to three weeks. Many symptoms may be exhibited, corresponding to the variations in the morbid processes. If the heart, digestive tract, liver, kidneys or brain become the localized seat of disease, symptoms referable to impaired functions of these organs are in evidence. The septicemic form has been described as being followed by localized suppurative lesions. The mortality is often high, in some epizoötics reaching 30 per cent. It frequently leaves animals practically worthless because of pleural adhesions and other complications. Isolation and disinfection are the important factors in checking its spread. To prevent the introduction of this malady, all horses brought from a distance should be kept isolated for at least a week before allowing them to come in contact with the home animals.

Apoplectiform septicemia in chickens.—This is a rapidly fatal septicemia in chickens caused by a streptococcus. The onset of the disease is very sudden and it usually terminates in death. It has been observed in but two or three localities. The prevention consists in the separation of the well from the diseased fowls and placing them in uninfected houses or yards.

Streptococcus mastitis.—This term has been given to an infectious disease of the udder of cows caused by a streptococcus. It is characterized by hard infiltrated areas in the gland. The diagnosis is made by finding the streptococcus in pure culture. It is to be differentiated from the sporadic cases of mastitis caused primarily by some injury, and the infectious mastitis caused by other bacteria, largely micrococci. Its spread can be stopped by disinfecting (washing in a disinfectant) the hands of the milker after each animal. The affected animal should be isolated from the others. It is one of the easiest infections to control.

Diseases caused by micrococci.

The micrococci or spherical bacteria cause many wound infections, although there is but one specific disease of animals caused by this genus of bacteria.

Takosis.—Takosis, meaning to waste, is a destructive, infectious disease of Angora goats. It is characterized by great emaciation and weakness, with symptoms of diarrhea and pneumonia. Takosis has been reported from a number of localities in this country, more especially in the northern states. According to Mohler and Washburn it is caused by *M. caprinus.* It is pathogenic for goats, chickens, rabbits, guinea pigs and white mice, but not for sheep, dogs or rats.

The first observable symptom is a listless appearance; frequently there is drooping of the ears and a drowsy appearance of the eyes, with a slight elevation of temperature in the beginning; but later in the course of the disease it becomes subnormal Rumination is seldom impaired, the appetite is usually good but capricious. The exposed mucous membranes are pale. The young are reported to be more susceptible to the disease than the older animals. The lesions vary, but emaciation and anemia are the most striking. The most destructive outbreaks have occurred among goats that had recently been shipped from a southern locality to a northern latitude. Sudden climatic changes should be avoided. Hobson states that the natives of Asia Minor assert that the goat cannot be transported from one village to another of higher altitude without suffering some deterioration. Angora goats should be provided with stables that are perfectly dry. These should be accessible at all times, as rains are very injurious. When the disease appears, all well animals should be removed from the sick ones.

[Hobson, Angora Goat Farming, Agricultural Journal, Cape Colony, Vol. VIII, p. 81 (1894); Mohler and Washburn, Takosis, A Contagious Disease of Goats, Bulletin No. 45, Bureau of Animal Industry, United States Department of Agriculture, Washington, D. C. (1903).]

Diseases caused by bacteria belonging to the genus Bacterium.

The genus Bacterium includes the non-motile rod-shaped bacteria.

Anthrax. (Figs. 111, 112.)—Anthrax is an infectious disease occurring sporadically and in epizoötics in herbivora and omnivora, and communicable to nearly all warm-blooded animals and to man. It is characterized by the presence in the diseased tissues and liquids of large numbers of *Bacterium anthracis*, an enlarged spleen, blood extravasations and local gangrene. It is a widely disseminated disease. The continent of Europe, perhaps, has suffered most from its ravages. In the United States it has been reported from at least fifteen states and territories. The bacterium of anthrax itself is not an especially hardy organism, but its spores are among the most resistant of bacterial life to chemical and thermal agents. They resist drying for months or years; and boiling for a half hour does not always destroy them. For this reason it is very difficult to eliminate the virus from infected pasture lands, especially if they are wet or marshy. As the spores may remain in the soil for many years, the disease may not appear until long after the introduction of the virus. Anthrax has been known to break out among cattle grazing on a field in which the carcasses of affected animals were buried several

years before. The period of incubation is very short; in inoculated animals it ranges from one to five days.

Nearly all species of animals suffer from anthrax. The herbivora and rodents are most susceptible.

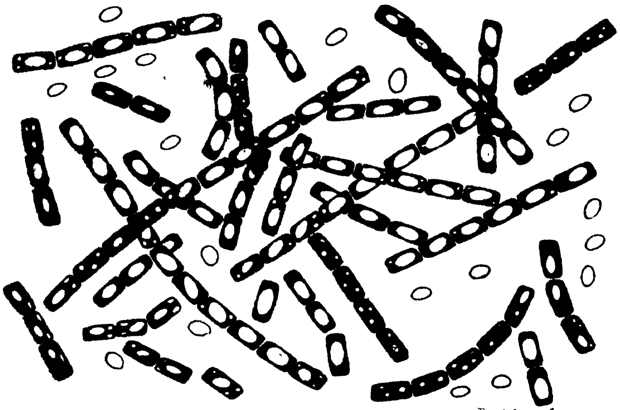

Fig. 111. A drawing of anthrax bacteria showing spores and granules.

Horses and mules are frequently attacked. The channels of infection are through the digestive tract, wounds in the skin and by the lung. In cattle the infection seems to be largely through the alimentary canal; in horses and sheep by the skin or digestive tract; in men through wounds of the skin and the respiratory tract. Although these are the usual methods there are many exceptions.

Anthrax has been classified according to its course as peracute, acute and subacute. The peracute or apoplectic anthrax gives rise to symptoms of cerebral apoplexy. The animal becomes suddenly ill, staggers about for a brief period and falls. There may be a bloody discharge from the mouth, nostril and anus. Death usually ensues in a few minutes to an hour. In the acute form, the disease runs a somewhat slower course, lasting usually not to exceed twenty-four hours. The temperature rises rapidly to 105° to 108° Fahr. With this there are signs either of congestion of the brain or of the lungs. If the brain is affected the animal becomes restless, excited, stamps the ground, rears in the air, bellows, runs to and fro, and finally goes into convulsions followed by stupor and death. The subacute form is known as anthrax fever or intermittent anthrax. The disease lasts one to several days, the average being about forty-eight hours. Anthrax resulting from infection of the skin and mucous membranes usually gives rise to local lesions which are spoken of as carbuncles. In man it is known as malignant pustule. The nature and extent of the tissue changes depend on the course of the disease.

It is important not to confuse anthrax with a number of non-specific disorders and accidental causes of death. The suddenness of the attack, and, in very virulent cases, the short duration of the disease, may tend to the mistaking of it for poisoning, cerebral apoplexy, pulmonary congestion, death from lightning, or acute gastro-intestinal inflammation. The affection known as "corn-stalk" disease is not infrequently taken for anthrax; and vice versa.

Pasteur's method of protective inoculation consists in inoculating the animal with a small quantity of culture which has been grown at a high temperature—42° to 43° C.—for several days. This deprives the bacteria of their virulence. To strengthen the resistance, the animals are again inoculated with a stronger virus. After the two inoculations, they are said to be protected against the most virulent anthrax virus; but the immunity is of short duration. The injection of anthrax antitoxin or serum together with a small quantity of virulent anthrax bacteria has proved to be very satisfactory. It has the advantage of being administered at one time. This method of protection against anthrax was first proposed by Sobernheim in 1899. It is known as the simultaneous method.

To prevent the spread of anthrax the well animals should be removed from the barns or yards containing the sick ones and from pasture lands on which the sick became infected. All infected stables and yards should be thoroughly disinfected. By careful isolation and safe disposition of the dead animals the spread of the disease can be checked. Animals, as a rule, do not spread the virus when the first symptom (rise of temperature) appears. The disposition of animals dead of anthrax is a matter of much importance. They should be burned if possible; if not, they should be buried deeply and covered with quicklime before the dirt is replaced. The ground over them should be fenced to prevent other animals grazing over it, and the surface should be burned annually for some years to destroy spores should they be brought to the surface.

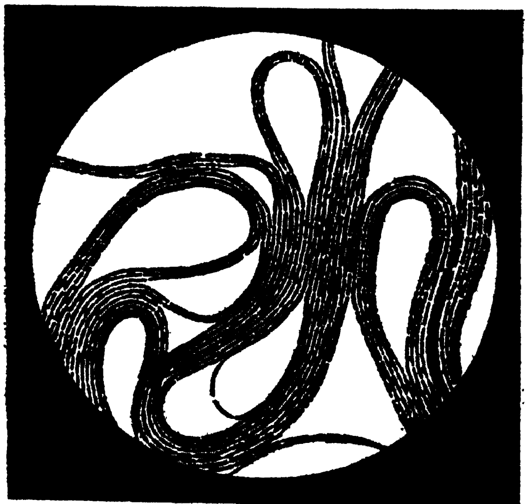

Fig. 112. A picture of anthrax bacteria from a preparation made from a gelatine plate.

[Chester, Anthrax, Bacteriological Work, Report

of Delaware Agricultural Experiment Station, p. 64 (1895); Chester, Protective Inoculation Against Anthrax, Proceedings of the Society for the Promotion of Agricultural Science, p. 52 (1896); Dalrymple, Anthrax and Protective Inoculation in Louisiana, Proceedings of the American Veterinary Medical Association, p. 147 (1901); M'Fadyean, Extraneous Sources of Infection in Outbreaks of Anthrax, Journal of Comparative Pathology and Therapeutics, Vol. XVI, p. 346 (1905); Moore, Report of an Outbreak of Anthrax, Annual Report, Commissioner of Agriculture of the State of New York (1897); Russell, Outbreak of Anthrax Fever Traceable to Tannery Refuse, The Seventeenth Annual Report of the Wisconsin Agricultural Experiment Station (1889).]

Asthenia in fowls and pigeons.—This is a disease especially of chickens and pigeons, in which there is marked emaciation and a failure to take on flesh even when fed on the most nourishing food. Because of this, the disease has received the popular name of "going light." Dawson gives a brief account of the symptoms, morbid anatomy, etiology, and a somewhat extended description of the specific organism (*Bacterium astheniæ*) which he isolated from the diseased chickens. The writer did not succeed in finding this organism in pigeons. The most conspicuous lesion is extreme emaciation. [Dawson, Asthenia (going light) in Fowls, Annual Report of the Bureau of Animal Industry, United States Department of Agriculture, p. 329 (1898).]

Fowl cholera.—This is an infectious disease of fowls, transmissible by cohabitation and inoculation. It is determined by a high fever, great weakness and prostration, and usually terminates in the death of the infected bird. It is reported that it attacks all varieties of domesticated poultry (chickens, ducks, geese, pigeons, turkeys) and caged birds, such as parrots and canaries. It also attacks some species of wild birds. It is communicable by inoculation to rabbits and mice; guinea pigs are less susceptible. Salmon investigated it in South Carolina in 1879–80. Higgins in 1898 reported it from Canada, and in 1904 Ward found it in California.

Fowl cholera is caused by a specific bacterium which is closely related to that of swine plague and septicemia hemorrhagica. The period of incubation is placed by European writers at 18 to 48 hours. In the case of 40 fowls inoculated by Salmon, it varied from 4 to 20 days, the average period being 8 days. Ward fed viscera of dead fowls to 10 healthy ones; they died in 24 hours to 6 days. The symptoms vary. Usually the appetite is lessened, but occasionally they continue to eat almost to the time of death. The earliest indication of the disease is a yellow coloration of the urates. The feathers are roughened, the wings droop, the head is drawn down towards the body and the general outline of the bird becomes spherical or ball-shaped. The liver is usually enlarged, softened, and the blood-vessels engorged. The gall-bladder is distended with thick, dark bile. Its duration varies from a few hours to several days. The prognosis is unfavorable. The mortality is very high, often 100 per cent. This disease may run rapidly through a flock, destroying the greater part of the birds in a week, or it may assume a more chronic form, spreading slowly, and remain on the premises for several weeks or months. A positive diagnosis is to be made in the findings of a bacteriological examination.

Prevention consists in good sanitary conditions, isolation of the well from the sick fowls and thorough disinfection. It is important not to introduce the disease with newly purchased fowls or to expose healthy ones to the disease, either at, or in transportation to, various poultry exhibits.

[Salmon, Annual Reports of the United States Commissioner of Agriculture (1880–82); Ward, Fowl Cholera, Bulletin No. 156, California Agricultural Experiment Station, Berkeley, California (1904).]

Fowl typhoid.—This disease was described by Moore as an infectious leukemia. It is caused by *Bacterium sanguinarium*. Little can be positively stated concerning the early symptoms. There is a pronounced anemia of the mucosa of the head. There is also a marked diminution in the number of red corpuscles and an increase in the number of white ones. There is an elevation of one to four degrees in temperature. The only constant lesions are in the liver and blood. The liver is somewhat enlarged and dark-colored; a close inspection shows it to be sprinkled with minute grayish necrotic areas.

Intestinal disturbances, especially diarrhea and fowl cholera, are the diseases to be mistaken for fowl typhoid. Prompt isolation of the well from the sick fowls and thorough disinfection of the houses and yards is the only preventive measure known.

[Curtice, Fowl Typhoid, Bulletin No. 87, Rhode Island Agricultural Experiment Station (1902); Moore, Infectious Leukemia in Fowls, A Bacterial Disease Frequently Mistaken for Fowl Cholera, Annual Report of the Bureau of Animal Industry, 1895–96.]

Glanders.—Glanders is one of the most important diseases of horses, asses and mules, and when transmitted to man, one of the most fatal diseases. It runs an acute or chronic course, attacking the lymphatic system more especially in the upper air-passages, lungs or skin. It is characterized by a strong tendency to the formation of small nodules, which are likely to degenerate into ulcers, from which exudes a peculiar sticky discharge. In the very acute cases a considerable rise of temperature and general debility may accompany the formation of the lesions. Glanders of the skin is known as farcy. Cattle, white mice, rats and domestic fowls seem to be immune.

Glanders exists in the greater part of the civilized world. It is more common in the temperate zones, probably because traffic in horses is more active. In the United States it was largely confined to the North before 1861, but it spread over the South in connection with the Civil war.

Its specific cause is *Bacterium mallei*. (Fig. 113.) It is found in recent nodules, in discharge from the

nostrils, in pus from the specific ulcers, and occasionally in the blood of animals affected with glanders. The period of incubation is not known; it evidently varies from a few to many days. The acute form is common in the ass and mule ; in the horse the chronic form is more usual. It may begin with a chill, but usually the onset is very insidious. In chronic glanders, the most frequent locations of the ulcers and nodules are on the respiratory mucous membrane, especially on the nasal septum, in the lungs, lymph glands and skin. Occasionally glanders manifests itself as a diffuse catarrh of the mucous membrane of the nasal and neighboring cavities, with superficial ulceration, thrombosis of the veins, and inflammatory infiltration of the sub-mucosa. Both the nodular and infiltrated forms are found in the lungs. In glanders of the skin (farcy), the nodules are found in the papillary layer, in the cutis, and in the subcutaneous and superficial intermuscular tissue. The cutaneous nodules vary in size from a hemp seed up to that of a pea. They suppurate rapidly and form small abscesses which discharge.

Fig. 113. The bacteria of glanders lying between masses of cells.

Glanders may be positively diagnosed by inoculating guinea pigs with the discharge from the ulcer, by the application of mallein, or by the effect of the blood serum of the suspected horse on the bacteria of glanders in a properly prepared test fluid. This last is known as the agglutination method of diagnosis. The prevention consists in isolation of the healthy animals from the infected ones and thorough disinfection of the stables. It is also desirable not to bring strange horses in close contact with home animals until their freedom from this disease is determined. If it develops in one animal in a stable, it is important that all horses which have been exposed, should be carefully watched and tested in order to be able to eliminate all infected animals before they are able to spread the disease.

[M'Fadyean, Glanders, Journal Comparative Pathology and Therapeutics, Vol. XVII, p. 295 (1904); Nocard, The Value of Mallein as a Means of Diagnosis in Doubtful Cases of Glanders, Journal Comparative Pathology and Therapeutics, Vol. VIII, p. 227 (1895); Schütz, A Contribution to the Subject of Glanders, Journal Comparative Pathology and Therapeutics, Vol. XI, p. 1 (1898); Williams, Glanders, Bulletin No. 4, Montana Agricultural Experiment Station (1894).]

Goose septicemia.—This is an acute septicemia of geese. It is caused by a bacterium belonging to the septicemia hemorrhagica group. It is not a common disease. The prevention consists in the isolation of the well from the sick, repeating the separations as often as new cases appear. The infected pens should be thoroughly disinfected before being reoccupied. [Curtice, Goose Septicemia, Bulletin No. 86, Rhode Island Agricultural Experiment Station (1902).]

Hemorrhagica septicemia.—This disease consists largely of hemorrhagic areas more or less widely distributed throughout the body and due to the presence of a specific microörganism. It usually runs a rapid course, terminating fatally. It is thought to be identical with the disease described by Bollinger under the name of *Wildund Rinderseuche,* an epizoötic disease which killed a large number of wild boars and deer in the royal game preserves of Munich. He reports it to be sudden in its onset and rapidly fatal in its course, with a mortality of 90 per cent. Death occurred in twelve hours to a few days after the first appearance of symptoms. In this country it seems to affect cattle more than other species. It is a wide-spread malady. It appears to be rather prevalent in the western and northern parts of the Mississippi valley. The period of incubation is supposed to be very short. The method of infection is not known and its duration is very short. The prognosis is unfavorable. The mortality is 80 to 100 per cent of all the animals affected. The characteristic lesions, especially in cattle, are widely distributed areas of hemorrhage, varying in size from a pin point to several centimeters in diameter ; and they vary in color from light red to almost black. The other morbid changes found in cattle are numerous.

Septicemia hemorrhagica in cattle must be differentiated from anthrax, symptomatic anthrax, and the affection known as "corn-stalk disease." Deaths from this disease must also be distinguished from those due to certain accidental causes, poisoning, or the effect of over-eating of grain or green fodder. The suddenness with which the animals may die renders the symptoms of little value in making a diagnosis. For this purpose it is necessary that a careful post mortem and bacteriological examination should be made.

The carcasses of animals that die should be burned or buried deeply with a good covering of a disinfectant. Should death occur in a stable, all contaminated litter should be burned and the floors, mangers and walls thoroughly disinfected.

[Reynolds, Hæmorrhagica Septicæmia, Bulletin No. 82, Minnesota Agricultural Experiment Station (1903) ; Wilson and Brimhall, Sixty Cases of Hemorrhagica Septicemia in Cattle Due to Bacillus Bovisepticus, Report of State Board of Health of Minnesota (1901). Latter contains very full bibliography.]

Ovine caseous lymph-adenitis (pseudo-tuberculosis in sheep).—Caseous lymph-adenitis is a disease of adult sheep which until recently was designated as pseudo-tuberculosis. It is characterized by an enlargement of one or more lymphatic glands, which contain foci of a greenish yellow, caseous or purulent substance. It is rarely found in young animals. The mortality is very low. It does not occur in epizoötic form although it is more prevalent in certain localities than in others. It is caused by a specific microörganism known as the bacterium of Preisz. [Nörgaard and Mohler, The

Nature, Cause and Economic Importance of Ovine Caseous Lymph-Adenitis, Sixteenth Annual Report, Bureau of Animal Industry, p. 638 (1899). (Full bibliography).]

Swine erysipelas.—This is an infectious disease peculiar to swine. It is determined by a rise in temperature, cerebral disturbances and pronounced reddening of areas of the skin. It is a disease of adult life. It is stated that pigs are rarely attacked under three months or over three years of age. Lydtin and Schottelius found some differences in the degree of susceptibility of certain breeds of swine; the common country pig was least susceptible. It occurs enzoötically and in epizoötics in most of the countries of Europe. It is caused by a very slender bacterium. The period of incubation is stated to be at least three days, although it is apparently longer than that in many cases. Jensen describes five distinct forms of this malady, namely, true erysipelas, swine urticaria, erysipelas without redness of the skin, diffuse necrotic erysipelas of the skin, and endocarditis of erysipelas. Its duration varies from one to ten days; in types of moderate severity it runs three to four weeks. The prognosis is unfavorable. There is 20 to 80 per cent mortality.

Swine plague.—Swine plague is an infectious disease of swine occurring sporadically and in epizoötics. It appears usually as a septicemia or a pneumonia in which there is marked consolidation of the ventral and cephalic lobes and the cephalic part of the principal lobe of one or both lungs. There may or may not be pleuritis. There may be marked changes in the intestine, consisting of superficial necrosis of the mucosa, especially in the ileum and cœcum. For this reason it has been considered by some writers as an infectious pneumoenteritis. It is a wide-spread disease in this country, occurring more or less frequently in every state.

Swine plague is caused by a non-motile, oval bacterium, described by Smith in 1886 (Fig. 114). It is identical with the bacillus of *Schweineseuche* described by Loeffler in 1885. This organism is very closely related to a large number of so-called species producing certain diseases in cattle, fowls and rabbits, also to one frequently found in the upper air-passages of healthy swine, cattle, horses, cats and dogs. It is often difficult to recognize symptoms distinctive of swine plague. Some animals die quickly of septicemia, others live a few days to a week or longer. Swine affected with the more chronic form eat very little or refuse food altogether; they cough considerably, especially when forced to run; the back is usually arched and the groins sunken; the whites of the eyes are reddened; the skin over the ventral surface of the body, nose and ears is frequently flushed or of a reddish color. The cough is the most reliable indication. There are many known variations in the appearance of the internal organs. The characteristic lesions are to be found in the lungs. Frequently the abdominal viscera appear to be normal, although a careful examination will usually reveal slight changes. In brief, the lesions of swine plague, as they appear in various outbreaks, may be summarized in four classes, namely: (1) The acute septicemic form in which the lesions are characterized by a general hyperemic condition of the serous membrane and organs. Not infrequently hemorrhages, especially the punctiform variety, occur. (2) Cases of pneumonia with or without pleuritis. The other organs remain normal in appearance. This is the more usual form. (3) Cases when either in addition to, or in the absence of the lung lesions there are marked changes in the mucosa of the digestive tract and perhaps in the lymphatic glands. (4) Cases of mixed infection, especially with hog cholera, when in addition to the swine plague lesions there are those, especially of the digestive tract, characteristic of the accompanying disease.

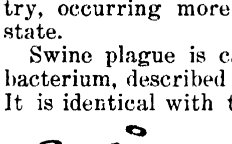

Fig. 114. The bacteria of swine plague or *Septicemia hemorrhagica*.

The duration of the disease varies in acute cases from a few days to several weeks. In chronic or complicated cases it is indefinite. The prognosis is very unfavorable. Most of the affected animals die, and those that recover are usually not thrifty. In sporadic cases swine plague is to be differentiated from broncho-pneumonia, due to other causes than the swine-plague bacterium. Pneumonia of a non-specific nature is often associated with deaths due to dietary or other causes. In epizoötics it is to be distinguished from hog cholera when there is accompanying catarrhal pneumonia. To make a positive diagnosis it is usually necessary to depend on the results of a bacteriological examination. If the disease appears, the well animals should be promptly separated from the sick and placed in suitable pens or yards, protected against subsequent infection and given an abundance of wholesome food and water. The thorough disinfection of the infected pens should be insisted on before they are again occupied.

[Moore, Pathogenic and Toxigenic Bacteria in the Upper Air Passages of Domesticated Animals, Bulletin No. 3, Bureau of Animal Industry, United States Department of Agriculture (1893); Smith, Special Report on Swine Plague, Bureau of Animal Industry, United States Department of Agriculture (1891).]

Tuberculosis (Figs. 115–119).—Tuberculosis is an infectious disease from which the human species, cattle and swine suffer very extensively, and which, under favorable conditions, attacks nearly if not all species of animals, including fish. It is a disease of slow development, involving either primarily, or in association with other organs, the lymphatic system. It is characterized by the formation of nodules, or tubercles, in consequence of the activities of *Bacterium tuberculosis*. It destoys life by a chronic and long-continued systemic poisoning and by the morbid changes brought about through the localization of these lesions in organs necessary to life. It is known as consumption, pearl disease, phthisis, scrofula, tabes, and in man as "the great white plague." Tuberculosis was

known to the Jewish people during their Egyptian captivity, and the ecclesiastical laws for many centuries contained numerous enactments against the consumption of flesh from tuberculous animals. In 1783, the Berlin Board of Health declared the flesh of affected animals to be fit for food. In 1865, Villemin showed that tuberculosis was due to a specific infection. He produced the disease in rabbits by inoculating them with tuberculous material from human subjects; he also produced the disease by feeding experimental animals and by causing them to inhale tuberculous material. In 1882, Koch discovered the specific bacterium of the disease. The bacterium of tuberculosis (Fig. 115) is readily cultivated on artificial media such as blood serum or glycerinated agar after it has been adapted to such artificial conditions. However, it is not easy to cultivate it directly from ordinary tuberculous tissues.

Although at the time of their discovery the tubercle bacteria from man and from animals were thought to be identical, they have been found to possess slightly different characters and properties. Those from cattle are shorter and thicker than those from man, their growth is slightly different on blood serum, and they are more virulent for cattle and other animals. We must look on the tubercle bacteria coming from different species of animals as races or varieties which, perhaps, are the result of their different conditions of life. The tubercle bacteria from fowls exhibit greater differences morphologically and have very little if any virulence for other animals. Those from fish are more widely separated.

As tuberculosis is a disease resulting largely from the destruction of tissue, the symptoms and duration

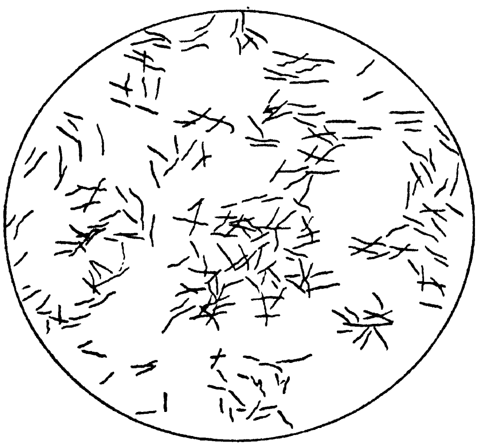

Fig. 115. A drawing of tubercle bacilli.

of its course vary largely according to the location of the lesions. When they are situated deeply and are not of great extent, they may not exhibit visible evidence of their presence. In such cases, the infected animal may present the picture of perfect health and show no disturbance of function. Some animals are slaughtered for beef without a suspicion of the presence of tuberculosis

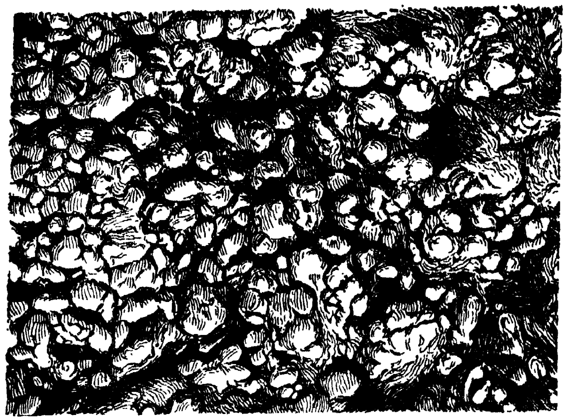

Fig. 116. Tubercular nodules on the pleura of the chest wall of a cow.

until they are examined post-mortem. There are no distinctive symptoms but a cough, rough coat, tight, harsh skin, loud respiratory sounds; and enlargement of the glands in the neck, in the groin or above the udder are very suspicious.

The symptoms of acute miliary tuberculosis, "galloping consumption," are rapid loss of flesh, depression, poor appetite, cough, weakness, rapid breathing, harsh respiratory sounds, some elevation in temperature, increased pulse rate and, sometimes, enlarged lymphatic glands. The course of this form of tuberculosis is always rapid and terminates in death. It occurs when large numbers of tubercle bacteria are discharged into the blood or lymph currents. They are then carried to other parts of the body, filtered out in the capillaries of the lungs, liver, spleen, kidneys and elsewhere, causing tubercular lesions in each of these localities (Fig. 116). The lesion from which the infectious material entered the circulation may have been a comparatively small nodule. This form of the disease is more likely to appear in young animals than in adults, and is more common among swine than in cattle.

The usual direct anatomical changes following the invasion of tubercle bacteria are the formation of nodules or tubercles. A tubercle is "a small nonvascular nodule composed of cells, varying in form and size, with some basement substance between them, and with an inherent tendency to undergo central necrosis." In a large number of cases, the individual tubercles are distinct and easily recognizable, while in others they are coalesced, forming a mass of necrotic tissue. The lesions vary, therefore, from well-isolated minute or larger nodules to masses or cavities containing a purulent, caseous, or calcified substance. The primary lesions are largely located in one of the five following organs: (1) in the lungs or the lymphatic glands draining them (Figs. 117, 118), (2) in the lymphatic glands about the head, (3) in the intestines and mesenteric glands, (4) in the portal glands or liver itself, and (5) in the generative organs and udder. In fatal cases of tuberculosis one may find with varying modifications one or more of the following

Fig. 117. Section of tuberculous lung of a cow. The light colored points are areas of calcification, the remainder is the cheese-like tuberculous material.

conditions: (1) The primary lesions may be found in any one of the organs or membranes. Its comparative age is determined by the character of the anatomical changes. It may be entirely encysted, caseous or calcareous and dead. In addition to the primary focus, there may be a succession of tubercles of various ages distributed in one or more organs. (2) The lesions may be restricted to one organ, as the liver, in which the primary focus has spread by continuity, due to its infiltrating nature, until the destruction of the tissues of the organ has become so extensive that death results. Such cases are not common. (3) The primary lesion may be well marked and accompanied by miliary tubercles sprinkled extensively throughout the organs and tissues of the entire body. (4) The lesions throughout the body may resemble each other very closely, so that difficulty may be experienced in determining the primary focus. When the primary infection is restricted to a single focus, the disease is said to be localized. When the specific bacteria are spread from the primary lesion through the agency of the lymph and blood streams, infecting other organs with the tubercle bacteria, each of which becomes the starting point for a new tubercle, the disease has become generalized.

Tuberculosis in swine.—Tuberculosis in swine is often generalized. Swine are usually infected through the food. If pigs are fed on the refuse from dairies and cheese manufactories in districts where there is much tuberculosis in cattle, or on tuberculous viscera, they readily become infected. In most cases, tuberculosis of the pig is first recognized at the abattoir; sometimes, however, it causes local and general troubles, which vary according to the organ attacked. The so-called scrofula of swine is tuberculosis of the glands of the head and neck. The manifestations of tuberculosis in swine are exceedingly interesting. Nocard found the lesions to consist of miliary granulations, which rapidly become caseous, as in cattle, but which more rarely contain calcareous salts. Generalization is common, in which case the viscera are thickly sprinkled with gray granulations, which are translucent throughout, or opaque in their centers, quite analogous to those found in tubercular lesions in other animals.

Avian tuberculosis.—In America, tuberculosis in fowls has been described by several workers. It was recognized by the owners as "spotted liver," going light, and rheumatism. The general symptoms are emaciation and anemia The comb, the skin, and the visible mucosa about the head are usually pale. As the course of the disease advances, the feathers become ruffled and the fowls are weak, dumpish, and move about very little; the appetite is usually good; the temperature is in most cases within the normal limits, but rarely it is subnormal; the blood is pale. Tubercular fowls are often lame; this is due to joint lesions in some cases; in others it appears to be due to extensive lesions in the viscera. The liver is most frequently involved. The spleen, intestines, mesentery, kidneys, lungs and skin are affected in the order mentioned. The structure of the tubercle is the same as in other animals.

Tuberculosis in cattle and swine is to be differentiated from actinomycosis, and various parasitisms resulting in nodules largely in the walls of the intestine, due to *Œsophagostoma*. In sheep the nodules are caused by *Œ. Columbianum*, Curtice. In chickens a nodular tæniasis of the intestine is not infrequently mistaken for tuberculosis. Abscesses

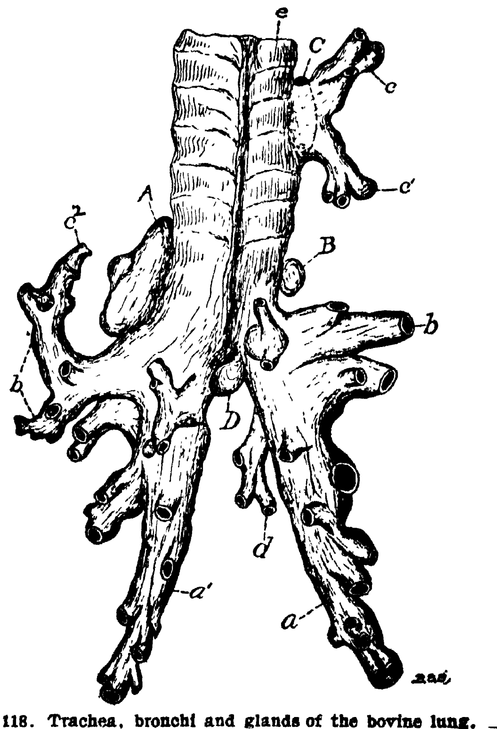

Fig. 118. Trachea, bronchi and glands of the bovine lung. B, D are glands frequently involved in tuberculosis. C is the gland of the supernumerary branches. It is often affected. (Smith.)

and necrotic foci due to various agencies must also be distinguished from tubercular lesions. The positive diagnosis of tuberculosis rests in: (1) Finding the tubercle bacteria in a microscopic examination of the lesions. (2) The production of tuberculosis in experimental animals by inoculating them with the suspected tuberculous material. (3) Securing a typical reaction after the injection of tuberculin.

Tuberculin test.—The tuberculin test, in a large majority of tuberculous cases among animals and in man, is the only means of detecting positively the disease in the living individual. Tuberculin is the concentrated liquid, usually glycerinated bouillon, on which tubercle bacteria have grown until the products resulting from their multiplication have become imparted to the medium in sufficient quantity to inhibit their further development. In its preparation the liquid is heated on

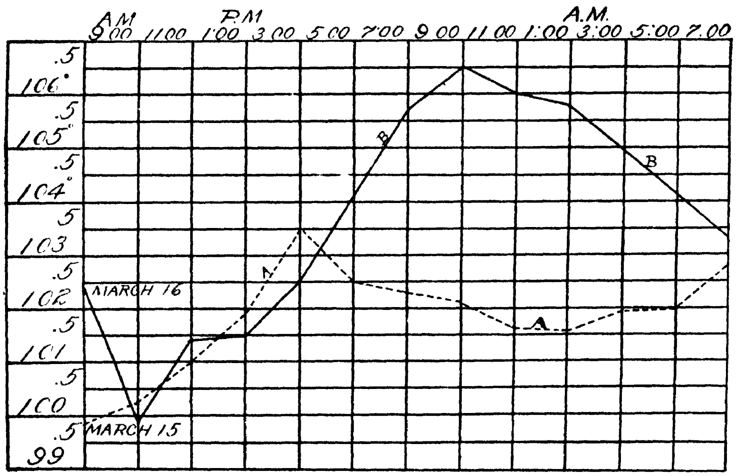

Fig. 119. Temperature curves. The dotted line A represents the temperature of a cow for twenty-four hours before the injection of tuberculin. The solid line represents the temperature for twenty four hours after the injection of tuberculin, showing the tuberculin reaction between 4 P. M. and 7 A. M.

two occasions to a temperature and for a length of time far in excess of that required to destroy the organisms, besides being passed through a filter capable of removing all bacteria. Tuberculin in the dose necessary to bring out its diagnostic effect is harmless for healthy animals. In the tuberculous animal it produces a rise of temperature which, within certain limits, follows a definite course, usually terminating in eighteen to twenty-four hours after the injection. (Fig. 119.) Occasionally the temperature remains above the normal for a longer time. The temperature usually begins to rise in about eight hours, giving a steady but rapid elevation for one to three hours, a continuous high elevation for two to six hours, possibly longer, and a gradual decline. This is practically constant, be the rise moderate or extreme. In addition to the elevation in temperature there is sometimes a marked nervous chill. It does not injure the diseased animal.

Tuberculosis prevention.—Tuberculosis can be prevented. To accomplish this it is necessary to keep tuberculous animals from entering the healthy herds. If they are admitted and later the fact is discovered, it is necessary to remove them and to thoroughly disinfect the stable. In eliminating the disease from a herd by means of the tuberculin test, it is necessary to retest the non-reacting animals after six months or a year have passed in order to find any case that might have been infected, but in which the lesions had not begun to develop at the time of the first test. Of the methods for the control of tuberculosis in cattle, the one introduced by Prof. Bang, of Copenhagen, Denmark, and generally known as the "Bang method," has proved to be the most successful. It consists in the slaughter of the advanced cases and the isolation of the reacting animals which show no evidence of disease, and keeping them for breeding purposes. The calves are separated from their dams immediately after birth and fed on the milk of healthy cows or the sterilized milk of the reacting ones. The vaccination of cattle against turberculosis has been proposed as a prophylactic measure. Von Behring has produced a vaccine, known as bovovaccine, for immunizing young cattle. The method is still in the experimental stage, and its effectiveness can not be predicted at this time.

[Koch, The Combating of Tuberculosis in the Light of the Experience That Has Been Gained in the Successful Combating of Other Infectious Diseases, American Veterinary Review, Vol. XXV, p. 441 (1901); Moore, A Report on Bovine Tuberculosis, New York State Department of Agriculture (1903); Moore, The Morbid Anatomy and Etiology of Avian Tuberculosis, Journal of Medical Research, Vol. XI, p. 512 (Bibliography) (1904); Pearson, The Repression of Tuberculosis in Cattle by Sanitation, Bulletin No. 74, Pennsylvania Department of Agriculture (1901); Ravenel, The Dissemination of Tubercle Bacilli by Cows in Coughing a Possible Source of Contagion, University of Pennsylvania Medical Magazine, November (1900); Smith, Investigations Concerning Bovine Tuberculosis with Special Reference to Diagnosis and Prevention (Pathological part), Bulletin No. 7, Bureau of Animal Industry, United States Department of Agriculture (1894); Smith, The Thermal Death Point of Tubercle Bacilli in Milk and Some Other Fluids, Journal Experimental Medicine, Vol. IV, p. 217 (1899); Pernot, Investigations of Diseases of Poultry, Bulletin No. 64, Oregon Agricultural Experiment Station (1900); Sibley, Tuberculosis in Birds, Journal Comparative Medicine and Veterinary Archives, Vol. XI, p. 317 (1890); Ward, Tuberculosis in Fowls, Bulletin No. 161, California Agricultural Experiment Station (1904).]

Diseases caused by bacteria, genus Bacillus.

The genus Bacillus in Migula's classification includes all rod-shaped motile bacteria. In the

older classification it includes both non-motile and motile forms. The fixing on motility as an essential generic character, and thus restricting the genus Bacillus to motile forms, is the occasion of some confusion between the genera Bacterium and Bacillus as applied to a number of important disease-producing bacteria. It is customary to speak of the bacillus of anthrax, of tuberculosis and of glanders, rather than of the bacterium of these affections.

Black leg or black quarter.—Black quarter is an acute infectious disease of cattle characterized by the development of an emphysematous swelling of the subcutaneous tissues and muscles. The lesions are usually located on and ordinarily extend over the greater part of a hind quarter of a shoulder. The disease does not spread from animal to animal by simple contact but the infection takes place apparently from a common source,—the soil. The virus seems to exist in the soil in certain localities only. Like tetanus, it is a disease following a wound infection. "Black quarter" is a disease of cattle, sheep and goats, although the two latter species are rarely attacked. Guinea pigs are very susceptible to inoculation but other animals seem to be immune. In cattle, it rarely occurs under the age of six months, and in adults after the fourth year. Black quarter exists to some extent in nearly every country in the world. The states and territories which suffer most from it are Texas, Oklahoma, Kansas, Nebraska, Colorado, North and South Dakota and Indian Territory; but a number of the other western states are badly infected.

Black quarter is caused by *Bacillus chauvœi*, an inhabitant of the soil in certain localities. The period of incubation is short. A general symptom is elevation of temperature, reaching in some cases 107° Fahr. It usually falls to the normal or even subnormal before death. The local symptoms may appear on different parts of the body except below the knee or hock joints and on the tail. They usually appear on the thighs, neck, shoulders and lower regions of the chest. After death the subcutaneous distension with gas is especially marked in the region of the swellings; the skin covering it is often gangrenous. The subcutaneous connective tissue is yellow, gelatinous, infiltrated with blood and bubbles of gas which escape if the skin is incised. The muscles underneath the tumors are of a dirty brown or of a blackish color. Its duration is one to three days, occasionally longer. The prognosis is grave.

In checking the spread of the black quarter it is very important to remove the well animals from the infected field and to restrict the sick ones to a small area. The swellings should not be opened and the discharge scattered over the field. The dead animals should be burned, if possible, otherwise buried deeply and covered well with lime as soon as possible after death. The most effective preventive measure is vaccination.

[Nörgaard, Blackleg in the United States and the Distribution of Vaccine by the Bureau of Animal Industry, Annual Report of the Bureau of Animal Industry, United States Department of Agriculture (1898); Salmon, Black Quarter, Annual Report of the Bureau of Animal Industry, United States Department of Agriculture (1893–4).]

Foot-rot in sheep.—Foot-rot in sheep is an infectious disease characterized by a specific inflammation of the tissues just above the horny part of the cleft of the foot, which extends downward, undermining the horny part. It appears in epizoötic and enzoötic forms. The cause, according to Mohler and Washburn, is an anaërobic organism, *Bacillus necrophorus*. The period of incubation is short. Its duration varies from a few weeks to several months. Usually it does not terminate fatally.

Hog cholera.—The distinguishing features of this disease are a continuous fever, ulceration of the intestines, and more or less discoloration of the skin, especially over the ventral surface. It is widely disseminated throughout the central part of the United States. It exists, however, to a certain degree in every state in the union and in Canada. In Great Britain it is known as swine fever. It prevails to a greater or less extent on the continent of Europe. It is caused by *Bacillus choleræ suis*. The period of incubation varies from seven to fourteen days, and perhaps longer. The symptoms are not constant. They are the acute and the chronic or mild forms. In the acute disease, the animals die very suddenly after a few hours, or at most a few days of sickness; in the other form the disease runs a longer course. The animals act dumpish and spiritless, and lie quietly in a corner or huddle together; they refuse to move when disturbed, and are more or less oblivious to their suffering. The appetite varies; there may or may not be diarrhea; frequently the bowels are costive; there is rarely any cough. Usually there is considerable reddening of the skin on the nose, ears, abdomen, and on the inside of the thighs and pubic region, and occasionally this reddening is very marked. Hogs suffering from various intestinal troubles frequently exhibit symptoms which closely resemble those of this disease. The lesions in the acute form are hemorrhagic or septicemic in nature. In the chronic form, which is more common, the lesions may be limited to the large intestines, although the spleen is usually enlarged and dark colored, and the liver, kidneys, and lymphatic glands are more or less affected. The duration of the disease varies, from a few hours in the acute septicemia type to one or more weeks in the chronic form. The prognosis is not good.

Hog cholera is to be differentiated from a great variety of dietary disorders and poisoning from alkalies and possibly from other chemicals, which may get into their food. Powdered soap has been found to produce a series of symptoms very similar to those of hog cholera. Hog cholera must also be differentiated from a new disease recently described by de Schweinitz, which resembles acute hog cholera symptomatically, but which is caused by an unknown organism that passes through a Chamberland filter. The differentiation of hog cholera from swine plague depends on the specific bacteria.

[Salmon and Smith, Annual Reports of the Bureau of Animal Industry (1885–1895); Smith, Hog Cholera Group of Bacteria, Bulletin No. 6, Bureau of Animal Industry, United States Department of Agriculture, p. 9 (1894); Smith and Moore, Experiments on the Production of Immunity in Rabbits and Guinea Pigs With Reference to Hog Cholera and Swine Plague Bacteria, *Ibid.*, p. 41; Welch, Report of Investigations Concerning the Causation of Hog Cholera, Johns Hopkins Hospital Bulletin No. 1 (1889).]

Tetanus.—Tetanus, or lockjaw, is an infectious disease (toxemia) in which the specific organism remains at the place of inoculation. It is characterized by spasmodic contraction of the muscles, referable to the nervous system, and by the absence of obvious tissue changes. It is the result of the absorption of the toxin produced by the tetanus bacillus. All mammalia, including man, are susceptible. It occurs most frequently in horses, asses and mules; next to them, in the smaller ruminants, such as the sheep and goat; it appears least often in the dog. It is reported to occur rarely in birds, and fowls are supposed to be immune. The human species is very susceptible. Tetanus is reported to be more prevalent in hot climates than in temperate ones, while in the very cold latitudes it is rarely if ever encountered. It is more frequently met with in some districts than in others. It is, however, a widespread disease. The tetanus bacillus forms spores which are at the end of the organism. (Fig. 120.) It is found in the soil. Mold rich in horse-manure seems to be the most favorable abode for it. The tetanus bacillus is very resistant, especially in its spore form, to destructive agents, such as drying and the ordinary disinfectants. Kitasato found that a 5 per cent solution of carbolic acid applied for ten hours failed to kill the spores. The period of incubation in horses is usually four to twenty days; after inoculation with pure cultures it is four to five days, and in sheep two to four days.

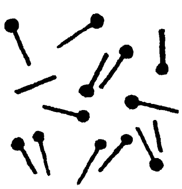

Fig. 120. The bacilli of tetanus, some with spores, others without.

The most common modes of infection are punctures, scratches, and pricks made by splinters, nails or infected instruments (traumatic tetanus). It may follow slight abrasions of the skin where infected earth comes in contact with the lacerated epidermis. Infection often occurs in young foals and lambs through the freshly broken umbilical cord (*Tetanus neonatorum*). The symptoms are often obscure and may be overlooked for several days or they may be ushered in suddenly with violent and extensive tonic spasms. The tetanic spasms usually begin in the muscles of the head and neck, extending from these to those of the throat, trunk and extremities. The muscles at the site of inoculation are frequently the first to show spasms and, if the disease is of a mild type, they may be the only ones to exhibit change. Besides the spasms the animal shows an increased reflex irritability and heightened sensibility. In fatal cases the temperature is usually constantly high toward the last. The primary tissue changes are in the motor ganglia cells of the anterior horns of the spinal cord due to a specific affinity between those cells and the tetanus toxin. A considerable number of lesions may be found elsewhere in the body, which are secondary to the tonic contractions.

The duration of the disease varies in different species and in different individuals of the same species. In the horse it may last for two or three days only, or it may continue for several weeks. In cattle the course is less rapid, but it rarely runs longer than two weeks. In sheep it may terminate fatally within a week and often in two or three days. Tetanus may be mistaken for cerebro-spinal meningitis, rabies and poisoning with strychnine.

Owing to the wide distribution of tetanus bacilli, precautions consist only in careful and thorough disinfection of all wounds. With animals at pasture, it is often impossible to know of the wounds until it is too late to apply this measure. In stables where the disease becomes prevalent, the floors and siding should be thoroughly disinfected and special watchfulness exercised to find at the earliest moment any injury by which infection could occur. Tetanus antitoxin is of value as a prophylactic.

[Moschcowitz, Tetanus, a study of the nature, excitant, lesions, symptomatology, and treatment of the disease, with a critical summary of the results of serum therapy, Studies from the Department of Pathology of the College of Physicians and Surgeons, Columbia University, Vol. VII (1899–1900) (M. gives pathology and antitoxin treatment, summary of cases and full bibliography.); McFarland, Tetanus and Vaccination, Journal of Medical Research, Vol. VII, p. 474 (1902).]

Diseases caused by fungi.

Actinomycosis.—Actinomycosis, also known as "lumpy jaw," "wooden tongue" and "big head," is a chronic disease determined by the presence of a specific cause,—the ray fungus, *Cladothrix actinomyces* (Fig. 121)—which by irritation stimulates the formation of new growths consisting of round cells, epithelioid cells, giant cells and fibrous tissue. The new growths appear as tumors having either a tendency to develop into large and hard masses or to suppurate. Cattle (genus Bos) are most often attacked. Horses, dogs, pigs, sheep and elephants are slightly susceptible. It is rarely found in man.

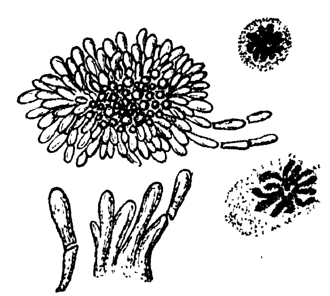

Fig. 121. A ray fungus, showing a rosette, branching and the invasion of cells.

Actinomycosis in cattle is widely distributed throughout North and South America and Europe. It is manifested by a firm swelling or tumor, usually situated in the region of the head or throat.

(Fig. 122.) The enlargement gradually increases in size. It is ordinarily sharply defined from the surrounding tissues. Upon manipulation the tumor feels hard and dense. In the region of the throat it may be fluctuating. After a variable length of time, the tumor-like mass may soften in one or more places, rupture and discharge a rather thick, yellowish and more or less sticky, purulent sub-

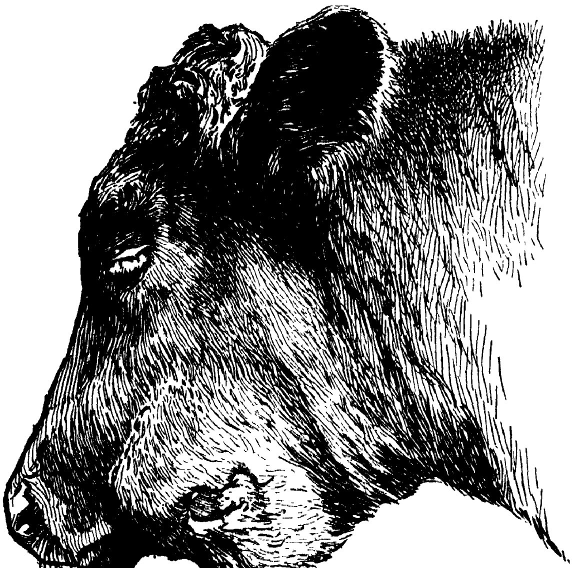

Fig. 122. Head of a steer showing actinomycosis of the jaw.

stance. The discharge may continue or, as often happens, the opening heals temporarily only to rupture again. Animals rarely die from its immediate effects. Mayo reports cases in which the disease was watched for several years. In cattle, it usually appears in one or more of the following locations : the maxillary bones, the tongue, the pharynx, the skin and subcutaneous tissue, the lymph glands and the lungs. It seldom attacks other organs. Rarely it becomes generalized. Investigations have proved the specific, curative effect of the administration of iodid of potassium.

[Salmon, Treatment of Lumpy jaw or Actinomycosis in Cattle, Bulletin No. 2, Bureau of Animal Industry, United States Department of Agriculture (1893); Wright, The Biology of the Microörganism of Actinomycosis, Journal of Medical Research, Vol. XIII, p. 349 (1905).]

Epizoötic lymphangitis.—Epizoötic lymphangitis is described as a virulent infectious disease characterized by suppuration of the superficial lymphatic vessels, due to the presence of a specific organism. It is a disease of the solipeds, although Tokishige reports finding it in cattle in Japan. It is caused by an organism described by Rivolta as *Saccharomycosis farciminosus.* According to Pallin, it is found in large numbers in the diseased tissues, partly free and partly enclosed in pus corpuscles, which often contain ten to thirty or more of them. The period of incubation is placed at three weeks to three months. The lesions consist of swelling and suppuration of the lymph vessels and glands. This affection may be mistaken for glanders. [Pallin, A Treatise on Epizoötic Lymphangitis, London (1904).]

Leeches.—"Leeches" or "leeching" is an infectious disease prevalent among the horse kind, with lesions localized on the skin or the mucosa of the head. It is more prevalent in the warm latitudes but it occurs further north. Its specific cause is not positively known but it is supposed to be a fungus.

Mycotic stomatitis in cattle.—Cattle sometimes suffer from stomatitis caused by fungi. The exact species that are involved in this form of infection are not clearly determined. The symptoms are inability to eat, suspension of rumination, frequent movements of the lips, and, in some cases, dribbling of saliva. The ulcers in the mouth are hemorrhagic at the borders, while the central necrotic parts soon slough. The prognosis is good.

Diseases caused by protozoa.

Protozoa are the smallest of known animal life. There are great numbers of them in nature but a very few species have become parasitic to the higher animals. A few species cause disease.

Canine malaria.—This is known as piroplasma of dogs, "malignant malarial jaundice" and "malignant jaundice." It is characterized by a high temperature, rapid course, jaundice and anemia. These are due to the invasion of the blood with *Piroplasma canis.* It has been found in several places in Africa, in Italy and in France. [Hutcheon, Malignant Malarial Fever of the Dog, The Veterinary Journal, Vol. XLIX, p. 398 (1899).]

Dourine.—This is a contagious affection of solipeds, transmitted by copulation and attended by specific lesions of the generative organs and nervous system, such as local swellings, dementia and paralysis. The disease is essentially an equine one. While the horse shows the greatest susceptibility, the ass is comparatively resistant to the infection. It is caused by a trypanosome. (Fig. 123.) In the active stages, the parasite is usually found abundantly in the blood, semen, milk, vaginal secretions and the erosions of the vaginal mucosa and penis. During intermissions, however, and in the absence of local lesions, the parasites are not found in the blood on microscopic examination, yet the inoculation of the blood into a dog will usually produce the disease. The parasite disappears from the blood and tissues very rapidly after death, so that, to prove successful, inoculations should be made from an infected individual before or immediately after death.

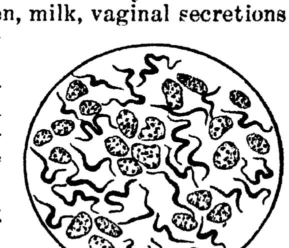

Fig. 123. A drawing of *Trypanosoma equiperdum*, the cause of dourine, in the blood of a rat eight days after inoculation.. (Doflein.)

The first symptoms are local changes in the gen-

ital organs, which appear after a period of incubation of eight days to two months. General symptoms develop only after weeks or even months; their appearance is often delayed until the local symptoms have disappeared. The animals are depressed aud weak, knuckle on their fetlock joints and lose control over the movements of their hind legs while walking. The temperature is not so high as in other forms of trypanosoma infection. Later in its course, a progressive paralysis of the hind quarters combines with excessive emaciation. Its duration is from three months to as many years. The prognosis is unfavorable. Dourine is to be differentiated from "Benign venereal disease."

Equine malaria.—This disease is characterized by a high temperature, and a yellowish tint of the mucous membranes. It is caused by *Piroplasma equi*, which is closely related to *P. bigeminum.*

Ictero-hematuria in sheep.—This is an enzoötic disease determined by a rise of temperature with a chill and later icterus and marked changes in the blood. It is due to *Piroplasma ovis*, which invades the red blood corpuscles. It has been described in Europe and in Montana.

Infectious entero-hepatitis in turkeys.—This is popularly called blackhead. It is characterized by thickening of areas or of the entire walls of the ceca and areas of tissue degeneration and necrosis in the liver. The New England states, particularly Rhode Island, and certain districts in the middle and western states, are affected. It is caused by a protozoan, *Ameba meleagridis*, discovered by T. Smith in 1895. As the disease progresses the turkeys become less active, lag behind their flock or do not go out with it. Later the comb, wattles and even the skin of the head become dark colored. Turkeys are attacked young.

The primary seat of the disease is the ceca. From these the liver is secondarily invaded. (Fig. 124.) The surface of the liver shows areas of a grayish, brownish or a more brilliant greenish yellow color. The present knowledge of this disease shows that the parasite is transmitted directly from diseased to healthy turkeys. This suggests that the first precaution is to avoid the entrance of diseased or seemingly healthy turkeys from a diseased flock into a healthy one. If the disease exists, the best although most radical method is the total destruction of the affected flock, thorough disinfection of the roosts and droppings under the same, and the introduction of healthy turkeys.

Fig. 124. Liver of turkey suffering from infectious entero-hepatitis, showing the grayish areas, characteristic of this disease.

[Cushman, Nature of Blackhead in Turkeys, Report Rhode Island Agricultural Experiment Station, p. 199 (1894); Moore, The Direct Transmission of Infectious Entero-hepatitis in Turkeys, Circular No. 5, Bureau of Animal Industry, United States Department of Agriculture (1896); Smith, Infectious Entero-hepatitis in Turkeys, Bulletin No. 8, Bureau of Animal Industry, United States Department of Agriculture (1895).]

Mal de caderas.—Mal de caderas (disease of the rump) is characterized by an intermittent fever, a progressive paralysis of the posterior parts, rapid emaciation and death. It is a "wet weather" disease. Horses, mules and asses are said to suffer from it. It is a disease of tropical South America caused by *Trypanosoma equinum.* The parasites are most numerous in the circulating blood during the rise of temperature. It has been proved that the virus is disseminated and animals are infected with it by means of certain insects. The first symptom is an elevation of temperature, which rises slowly, but suddenly falls to normal. Emaciation is rapid. The urine is dark colored and usually contains albumin and perhaps blood. The most obvious symptom is a symmetrical or asymmetrical paresis of the hind legs. The duration of the disease varies from a month to a year, or longer.

Nagana.—Nagana is a disease characterized by anemia and rapid emaciation, caused by a trypanosome. It attacks horses, mules, zebras, cattle and sheep. A number of the smaller animals are susceptible. It is known to all dialects as the tsétsé-fly disease. It is found in the central and southern parts of Africa. There seems to be some doubt about its identity with the disease of a similar nature in the Transvaal. Livingston discovered it in Central Africa. The trypanosoma are transmitted from the diseased to the healthy animals by means of the tsétsé-fly (*Glossina morsitans*, which exists in certain parts of Africa. It appears that this is the only species of insect responsible for its transmission. The affection is extended into uninfected areas by the introduction of diseased animals. In cattle the symptoms are not usually so acute as in the horse. Its duration is said to vary from a week to six months or more. The appetite remains good until the end. [Plimmer and Bradford, A Preliminary Note on the Morphology and Distribution of the Organism Found in the Tsétsé-fly Disease, The Veterinarian, Volume LXXII, p. 648 (1899).]

Surra.—Surra is an infectious disease of solipeds and camels caused by a flagellate protozoa, *Trypanosoma Evansi.* It is determined by a continuous fever with alternate paroxysms and intermissions, with a generalized or local eruption of the skin, petechiæ of the mucous membranes and more or less subcutaneous edema. There is rapid emaciation and great weakness. It is usually fatal. It attacks horses, asses, mules, goats, dogs, and rats. It can be inoculated into other animals such as rabbits and guinea pigs. From an economic point of view it is essentially a disease of horses. It occurs in Asia and Africa. It does not exist in the United States, but because of its prevalence and long standing in the Philippines it is liable to be introduced into this country. The specific trypanosome is invariably found during the paroxysms in the blood of the infected animals. Although the blood during an intermission may appear under the microscope to be absolutely free from the parasites, its inoculation into sus-

ceptible animals, as a rule, will produce the disease. The period of incubation may be put at six to eight days after inoculation or ingestion of blood taken from an animal suffering from surra.

The most common demonstrated natural method of transferring the virus from infected to non-infected animals is by means of insects, especially the biting flies. The disease is spread from one locality to another by the introduction of animals carrying the parasite.

The chief symptoms are the occasional appearance of an urticarial eruption, closely following the first rise of temperature, but which may make its appearance at any time during the course of the disease. There is extreme pallor of the visible mucous membranes. From first to last there is progressive anemia; the blood at first presents a normal character, but after a varying period of time it undergoes marked changes. The white corpuscles are increased in number and the red corpuscles usually cease to form normal rouleaux, lose their individuality and run together, forming irregular masses. Its duration, according to Gunn, is about fifty-two days. In the Philippine islands the duration in horses is fourteen days to three months. The prognosis is always unfavorable, the mortality in most species of animals being 100 per cent.

Surra is to be differentiated from anthrax and the other trypanosoma diseases. It may be complicated with broncho-pneumonia, rinderpest and foot-and-mouth disease. One attack does not protect a horse from a subsequent one. The importation of animals from infected countries should be prohibited. If the disease gains entrance, the infected animals should be destroyed.

[Musgrave and Clegg, Trypanosoma and Trypanosomiasis, with Special Reference to Surra in the Philippine Islands, Bulletin No. 5, Bureau of Government Laboratories, Manila (1903); Salmon and Stiles, Emergency Report on Surra, Bulletin No. 42, Bureau of Animal Industry, United States Department of Agriculture (1892).]

Texas fever —Texas fever is an infectious blood disease of cattle, characterized by a rise of temperature, hemoglobinuria, destruction of the red blood corpuscles and the presence in the blood of a protozoan parasite which is transmitted from animal to animal by means of the cattle tick. It is thought to be identical with the hemoglobinuria in Roumania, tick fever in Australia, and "La Tristeza" in South America. It has been named *Malaria bovine* by Lignières. Although it differs in many ways from human malaria, the analogy is so close respecting the specific cause, wide distribution and means of transmission, that bovine malaria seems to be a very suitable name for this affection. The peculiar and interesting feature of this affection is the fact that cattle raised in the infected districts become immunized so that they do not suffer from the disease, but they carry its specific organism in their blood. When imported into non-infected districts, they transmit the virus by means of the cattle tick to susceptible animals, but themselves remain perfectly well. In the United States the distribution of Texas fever corresponds with that of the cattle tick (*Boöphilus annulatus*).

Texas fever is caused by *Piroplasma bigeminum* (Fig. 125), which is found in the blood of affected cattle. The life history of this parasite is not determined. In the blood of the diseased animal the organisms appear in the unstained, fresh preparation as minute or larger bright bodies. One end of each is broad and rounded, the other tapering and pointed. Usually there are two of these bodies, both of the same size, in a corpuscle. More rarely there is but one, although four are occasionally observed. In the capillaries of the congested organs, the blood corpuscles contain many more parasites. Although practical stockmen had long looked on the tick as the source of infection, it remained for Smith and Kilborne experimentally to demonstrate that so far as known the cattle tick is the sole carrier of the parasite.

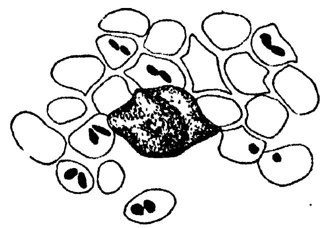

Fig. 125. A drawing from a smear preparation showing *Piroplasma bigeminum* in the red corpuscles, from the kidney of an animal suffering from Texas fever.

The life cycle of the tick will explain the variation in the time elapsing between the exposure of northern to southern cattle and the appearance of the disease. Starting with tick-infested animals placed with native cattle in a northern pasture, the adult female tick drops to the ground almost daily, so that the following life cycle may be assumed to begin at once: Adult ticks drop to the ground in one to three days after the infested cattle are placed in the field; adult ticks lay their eggs in about seven days after dropping to the ground; eggs are hatched in about twenty days after they are laid; young ticks crawl on cattle in one to several days after they are hatched; in about ten days from the time the young ticks crawl on the susceptible cattle the rise of temperature appears. Small quantities of the blood from immunized cattle in the tick-infected district, when injected into susceptible animals either intravenously or beneath the skin, will produce the disease. Usually the spleen is much enlarged. The liver is extensively affected, enlarged, congested, edges rounded, the bile ducts more or less distended and the cells usually in a state of fatty degeneration.

The preventive measures consist in the elimination of the tick. It has been shown that immunity against a fatal attack of Texas fever can be conferred on susceptible cattle by inoculation with the blood of a native Southern animal or one which has recently been rendered immune. Louisiana offers to immunize (free of charge) northern cattle, if they are shipped to the state for its stockraisers.

[Dalrymple, Morgan and Dodson, Texas or Southern Cattle Fever, Bulletin No. 51, Louisiana Agricultural Experiment Station (1898); Mohler, Texas

Fever, Bulletin No. 78, Bureau of Animal Industry (1905); Nörgaard, Dipping Cattle for the Destruction of Ticks, Annual Report, Bureau of Animal Industry, p. 109 (1895–6); Smith and Kilborne, Texas Fever, Bulletin No. 1, Bureau of Animal Industry (1893).]

Infectious diseases for which the specific cause is not yet determined.

Contagious pleuro-pneumonia in cattle.— This is a specific epizoötic disease which affects bovine animals and from which other species are exempt. When the disease results from exposure in the usual manner, it is characterized by an inflammation of the lungs and pleuræ. The disease has been brought to the United States several different times. Probably its first introduction was in a diseased cow sold in Brooklyn, N. Y., in 1843. In 1886, it was discovered in some of the large distillery stables of Chicago and among cows on neighboring lots. Its eradication was successful.

The specific cause of contagious pleuro-pneumonia has not been demonstrated. The infection may be introduced either by diseased cattle or, less commonly, by cattle-dealers, attendants, utensils, fodder, dogs and other means. The sheds in cattle markets are very dangerous centers for the dissemination of the disease. All cattle are not equally susceptible.

Anatomically, contagious pleuro-pneumonia is a progressive interstitial pneumonia with secondary hepatization of the lungs and exudative pleuritis. The anatomical changes vary according to its duration. It has frequently been mistaken for an interlobular pneumonia of cattle, which is more or less common in this country.

[Salmon, Annual Reports of the Bureau of Animal Industry, United States Department of Agriculture (1884–1892); Smith, Annual Report of the Bureau of Animal Industry, p. 143 (1895–6).]

Diphtheria in fowls.—Diphtheria of birds, also known as "roup," first appears on the mucous membrane of the head (nasal passages, the eyes, the mouth, the pharynx and larynx or sinuses). Avian diphtheria is quite distinct from human diphtheria. The lesions may extend to the trachea, bronchi, the air-sacs, the intestines and, possibly, to other abdominal organs. The disease is determined by a grayish yellow, fibrinous exudate which forms on the mucous surface of one or more of the parts mentioned. The exudate may be so abundant as to obstruct the passages. In some outbreaks, it progresses with great rapidity and destroys most of the birds attacked. Fowls (genus *Gallus*) and pigeons (genus *Columba*) are most commonly attacked. The cause is not known. It is usually introduced into a flock by the exposure of the fowls to sick ones at shows or by bringing affected ones on the premises. The contagion may be carried by birds which have the disease in so mild a form that they show no symptoms of it. There is a general belief that the disease may be developed by exposure to draughts of air or by keeping the fowls in damp, filthy and badly ventilated houses. The first symptoms are a watery secretion from the nostrils and from the eyes, with general weakness and prostration greater than would be expected from simple catarrh. There is a rise of temperature.

Three stages or varieties of lesions, which represent the types of this disease as encountered in this country, are as follows: (1) An exudate of a serous or muco-purulent character in the conjunctiva and nasal cavities. The mucosa in these cases is apparently but slightly altered. (2) The mucosa over a small or larger area is covered with a spreading exudate of a grayish or yellowish color. It is firmly attached to the mucous membrane, and when removed leaves a raw, bleeding surface. (3) The mucosa is covered with a thick mass of exudate, varying in color from a milky white to a lemon-yellow or brown. It is easily removed, leaving a more or less granular and healed surface. This sloughed mass is frequently dried at its margins to the adjacent tissue. It emits a strong putrid odor, due to decomposition. The drying of the margins prevents the fowl expelling the exudate after it becomes separated from the underlying tissue.

To prevent this disease the following rules, in addition to general sanitary methods, should be observed: (1) Fowls which have an exudate on any of the mucous membranes of the head, or which have come from flocks in which such a disease exists, or has recently existed, should not be placed among healthy poultry. (2) If the disease appears in one or more fowls of a flock, they should be separated immediately from the well ones. (3) The common practice of allowing fowls from different flocks to run together during the day should be discouraged. (4) Care should be taken to avoid the possibility of bringing the virus of the disease from affected flocks in the dirt or excrement, which naturally adheres to the shoes in walking through an infected chicken-yard. The same care is necessary in the interchange of working implements, such as shovels, hoes and the like. Ward has found that this disease can be prevented by keeping infected fowls away. The most certain of the known methods of treatment is the local application of disinfectants. The dipping of the heads of fowls in a solution of 1 to 2 per cent of permanganate of potash, or a 3 per cent solution of creolin, is reported to be very effective in cases in which the lesions are external and in the early stages.

[Harrison and Streit, Roup: An Experimental Study, Bulletin No. 132, Ontario Agricultural College and Experimental Farm (1903); Mack, The Etiology and Morbid Anatomy of Diphtheria in Chickens, American Veterinary Review (January 1905); Ward, Poultry Diseases in California, Proceedings of the American Veterinary Medical Association, p. 164 (1904).]

Dog distemper.— This is an infectious disease appearing in sporadic cases or in epizoötics. It is usually determined by a rise of temperature, loss of appetite and lassitude, followed by a catarrh of the conjunctiva, respiratory passages and digestive tract. Frequently there are serious disturbances of the nervous system. It is the most important canine disease. It is reported that cats, wolves, foxes,

jackals, hyenas and monkeys suffer from it. Its specific cause has not been demonstrated.

Epithelioma contagiosa.—Epithelioma contagiosa, or chicken-pox, as it is more often called in this country, is characterized by the development of nodular-like growths on the mucosa and skin of the head and neck. It is readily transmitted among fowls.

Foot-and-mouth disease.—Foot-and-mouth disease is a highly infectious disease of animals. It is determined by the eruption of vesicles in the mouth, around the coronet of the foot, on the udder and between the toes. It is said to be more common among cattle, but swine are susceptible; sheep, goats, horses, and dogs are sometimes attacked. People may be infected by drinking the unboiled milk of animals suffering from the disease. The mortality is not high. This disease is very largely restricted to Europe, although it has been introduced into almost every cattle-raising country. In 1870, it was brought to the United States from Canada. In 1884, and again in 1902, it invaded this country. In 1902, it appeared in New England. A total of 4,712 cattle were affected. The comparative freedom of the United States from this disease is attributed to the enforcement of rigid quarantine measures.

The specific cause is not known. The virus is contained in the eruptions, causing its wide distribution. Loeffler and Frosch have shown that the cause passes through a Berkefeld filter. The period of incubation is short. The first evidence of the disease is a rise of temperature, which in cattle rarely exceeds 104° Fahr. The mucous membrane of the mouth becomes reddened, the appetite is diminished, and rumination ceases. The mouth is usually kept closed and the quantity of saliva is increased. In addition to the changes in the mouth, one or more feet may become diseased. The udder, more particularly the teats, may be the seat of lesions.

The duration of the disease in uncomplicated cases varies from ten to twenty days. The mortality varies with the severity of the attacks, the age and condition of the animals and the treatment. Ordinarily it is not high, excepting in very young animals. It must be differentiated from various forms of stomatitis caused by injuries and by different fungi, from actinomycosis of the tongue, and from variola.

[Peters, Foot and Mouth Disease, Second Semi-annual Report of the Chief of the Cattle Bureau, Massachusetts State Board of Agriculture, p. 321 (1903); Salmon, Foot and Mouth Disease, Yearbook, United States Department of Agriculture, p. 643 (1902); *Ibid.*, Annual Report of the Bureau of Animal Industry, p. 391 (1902).]

Fowl pest.—This is a very acute and rapidly fatal disease of fowls caused by an ultra-microscopic organism that passes through the Berkefeld and Chamberland filters. Pigeons succumb to inoculation. Guinea pigs and mice are not susceptible.

Infectious abortion.—The disease or condition known as infectious abortion consists in the expulsion of the immature fetus, usually before it has sufficiently developed to live after birth, by a large proportion of pregnant animals that are kept together. Usually the abortion occurs in cattle between the fifth and eighth months of gestation. The disease as described by European writers is characterized by certain morbid changes in the uterine mucosa and fetal membranes. American observers have not described these changes. In cattle it usually affects the young cows. After two or three consecutive abortions, as a rule, cows become immune to it. Cows suffer most from this condition, although mares, ewes, and other species are occasionally reported to be affected.

Dairymen have found that if they keep animals that abort away from their sound cattle the trouble does not appear. As it affects young cows, it is the practice in some places to keep the young animals separated from the others until they have become free from the disease or at least until they have passed the period when it is likely to occur, after which they are admitted to the herd of older cows with impunity. When the trouble has entered a herd, the best prophylactic is thorough disinfection of the stable and frequent washing with a disinfectant of the vagina and external genetalia of the cows that have been exposed. All new cows that are purchased should be isolated from the herd until after parturition has occurred at full term. The disinfectants that have been used with success for external application are 5 per cent carbolic acid, 4 per cent creolin, 1 to 1,000 corrosive sublimate, and a solution of copper sulfate containing forty grams per liter of water. The last two may be used for vaginal douches.

[Bang, The Etiology of Epizoötic Abortion, Journal of Comparative Pathology and Therapeutics, Vol. X, p. 125 (1897); Dalrymple, Bulletin No. 10, 2d Series, Louisiana Agricultural Experiment Station (1891); Law, Contagious Abortion in Cows, Report of the New York State Commissioner of Agriculture (1897).]

Infectious cerebro-spinal meningitis in horses.—This is a disease that seems to be infectious in its nature, exhibiting symptoms referable to a disturbance in the central nervous system. It is called epizoötic cerebro-spinal meningitis because it often attacks a number of animals in the same locality. Although the literature contains numerous accounts of its seemingly contagious nature, an analysis of the facts fails to bring forth conclusive evidence that it is ever transmitted directly from one horse to another. In nearly all outbreaks, the animals affected have been subjected to like conditions of life. This disease, at the present time, is peculiar in that its cause is not known, that obvious tissue changes are usually absent, and that it has a very high mortality. The mildest attacks are manifested by loss of control of the limbs, loss of power over the tail, impairment of appetite and some difficulty in swallowing. In the more favorable cases, improvement may begin on the third or fourth day. [Martin, Cerebro-spinal Meningitis, American Veterinary Review, Vol. XXI, p. 289.]

Influenza.—Influenza is an acute infectious disease characterized by a rise of temperature and a

catarrhal condition of one or more of the mucous membranes, more especially of the head. It usually appears in epizoötic form. It is a disease of horses, although asses and mules are susceptible. It is known as "epizoötic catarrhal fever," "horse distemper," "pink eye," "mountain fever" and "shipping fever." Influenza is a generic term employed to designate a large variety of symptoms. It seems to be produced by some specific infection. It spreads rapidly among horses. The virus appears to lose its virulence quickly outside of the animal body, but within the body it seems to be preserved for a long time. In many cases one attack confers immunity, but a second infection or a relapse frequently occurs. The period of incubation and its duration vary from six to ten days. The mortality varies from 5 to 7 per cent. Without a definite, recognizable etiological factor or other exact tests, a positive diagnosis in doubtful cases can not be made.

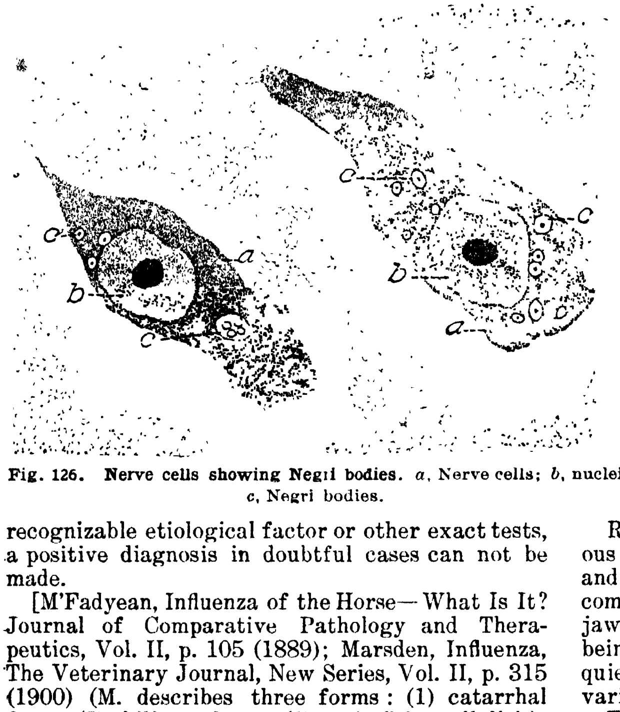

Fig. 126. Nerve cells showing Negri bodies. *a*, Nerve cells; *b*, nuclei; *c*, Negri bodies.

[M'Fadyean, Influenza of the Horse—What Is It? Journal of Comparative Pathology and Therapeutics, Vol. II, p. 105 (1889); Marsden, Influenza, The Veterinary Journal, New Series, Vol. II, p. 315 (1900) (M. describes three forms: (1) catarrhal fever, (2) bilious fever, (3) epizoötic cellulitis); Nelson, Influenza, State Agricultural Experiment Station, Pullman, Washington (1896).]

Rabies.—Rabies, or hydrophobia, is an acute infectious disease, transmitted from animal to animal or from animal to man by the bite of the rabid individual or by direct inoculation. It is not known to be contracted or transmitted in any other manner. It is characterized by a long and variable period of incubation, followed by symptoms referable to the nervous system, lasting one to ten days and ending in paralysis and death. There are no recognizable gross tissue changes. The dog is the animal most commonly affected, although all of the canine and feline races suffer from it more than other species, and cattle, sheep, hogs and horses are often attacked. An explanation for its greater frequency among dogs is found in their tendency to bite each other.

Rabies was first described by Aristotle. It is known to exist in almost every country on the globe. Australia is the largest area which is said to be absolutely free from it. This exemption is the gratifying result of a rigid quarantine enforced against dogs imported on that island. It is known that its cause exists in the brain, spinal cord and saliva of the affected animal. It 1903, Negri, of the University of Pavia, described small bodies or cell inclusions, since called Negri bodies (Fig. 126), which he found in the Purkingie cells of the cerebellum and in the large ganglion cells of the Ammons horn. Negri held these bodies to be the cause. They are of great value in diagnosis.

The period of incubation is variable, depending on the site of the wound, which is almost always a bite, the amount of virus introduced and its virulence. In general, it may be said for all animals that the period of incubation seldom exceeds sixty days, although there are cases in which it has been much longer. The average period as given by Ravenel, is as follows: in man, 40; dogs, 21 to 40; horses, 28 to 56; cats, 14 to 28; pigs, 14 to 21; goats and sheep, 21 to 28; and in birds, 14 to 40 days. In rabbits inoculated subdurally with the brain from rabid animals, the writer has found the period of incubation to vary from twelve to sixty-two days and the duration of the disease to range from a few hours to three days.

The somewhat popular opinion that most of the cases of rabies occur in the summer, especially in "dog days," is not founded on facts. Rabid dogs are nearly, if not quite, as numerous in winter and early spring as in summer.

Rabies is generally divided into two forms, furious and dumb. In the first the animal is irritable and aggressive and bites nearly every object which comes in its way; in the second the muscles of its jaw are paralyzed almost from the beginning, and, being unable to bite, the animal remains more quiet and tranquil. The duration of the disease varies from two to ten days.

The prevention of rabies resolves itself into two procedures: (1) The destruction of all ownerless and vagrant dogs and (2) the muzzling of all dogs that appear on the streets or in public places. In thus preventing the propagation of the virus, as shown by the results obtained in Germany and Great Britain, the disease will be practically exterminated. There is no treatment. The preventive inoculation known as the Pasteur treatment is effective when applied immediately after being bitten. Rabies causes heavy losses in the United States.

[Moore and Fish, A Report on Rabies in Washington, D. C., Annual Report, Bureau of Animal Industry (1895–6); Salmon, Rabies: Its Cause, Frequency and Treatment, Yearbook, Department of Agriculture, Washington, D. C. (1900); Way,

The Negri Bodies and the Diagnosis of Rabies, American Veterinary Review, Vol. XXIX, p. 937 (1905).]

Rinderpest.—Rinderpest is the most fatal disease affecting cattle. It is a specific eruptive fever, occurring both sporadically and in epizoötics. It is characterized by a more or less typhoid condition, with lesions largely located in the mucosa of the digestive tract and skin, and by the infectious nature of all the tissues, secreta and excreta. It is a disease peculiar to cattle, although other ruminants are susceptible to it. Rinderpest is a well-known plague in Russia and the steppes of central Asia. It has extended from time to time from its home in Russia and Asia to nearly every country in Continental Europe and Asia. More recently it has occurred in southern Africa. It has been introduced into the Philippines. It has not been introduced into the United States or other American countries.

[Jobling, Report of the Director of the Serum Laboratory, Fourth Annual Report of the Philippine Islands (1903); also *Ibid.*, Bulletin No. 4, Bureau of Government Laboratories, Manila (1903); Koch, Report, The Veterinary Journal, Vol. XLV, p. 204 (1897); also Centralbl. f. Bakter., Bd. XXI, S. 526 (1897).]

Variola in animals.—The disease in animals known as variola is characterized by a rise of temperature followed by a skin eruption consisting first of papules, then of vesicles and finally of pustules. It is common to horses, cattle and man. Sheep suffer from a like or similar disease. Other species are said to be attacked occasionally. The symptoms vary somewhat in the different species, but the essential ones are a rise of temperature and the appearance of a definite eruption on the skin or mucous membranes. It is rarely a dangerous affection in animals and often it is very mild. In sheep and goats it is known as clavelée.

Immunity and protective inoculation.

Immunity.—In a broad sense, immunity is "resistance to disease." The term, however, is usually restricted to the infectious maladies and signifies a condition of the individual which enables it successfully to defend itself against the invasion of its tissues and organs with the infecting micro-organisms or to resist the toxic effects of the invading organisms should they gain entrance and multiply within the body. While it usually applies to the action of pathogenic bacteria, the protozoa are not excluded. It will be seen that immunity is only relative; it is neither permanent nor constant, but varies with natural and artificial conditions. According to the process by which it is established in the individual, immunity is recognized as natural or artificial.

Natural immunity has been applied to that condition or ability possessed by some races or species of animals that enables them to resist the natural invasion of infecting organisms which attack other species or varieties of animals. In so far as we know, it is a condition inherent in the very nature of the individual, born with it and transmitted to its offspring. Thus, the Algerian race of sheep are immune to natural infection of anthrax, whereas other sheep are very susceptible to it. Natural immunity usually persists under ordinary conditions throughout life and in that respect it is much more permanent than artificial immunity.

Artificial immunity is brought about in the individual after birth. The most common form is found in individuals who have survived an attack of an infectious disease, such as smallpox and yellow fever in man and Texas fever in cattle. In some infectious diseases, as tuberculosis, there seems to be very little if any increased power of resistance imparted to a patient who has recovered from the first attack. There is great variation in the period of its duration. Artificial immunity is produced: (1) By inoculating the individual with a non-lethal dose of a strong virus. This is practiced in immunizing cattle against Texas fever, sheep-pox and contagious pleuro-pneumonia. (2) By inoculating the individual with attenuated virus. This is practiced in anthrax, black leg, chicken cholera, rouget, and rabies and bubonic plague in man. (3) By inoculating the individual with a vaccine consisting of the virus of the disease modified by continual passage through another species of animal, as vaccine for smallpox. (4) By the injection of toxins. This is used for immunizing animals, such as horses, against the virus of the diseases for the purpose of procuring antitoxin from their blood, as in diphtheria and tetanus. (5) By the injection of antitoxins. These are used to immunize animals against toxins, and children against natural infection, as in diphtheria. This is called passive immunity. Active immunity is produced by the injection of a living virus or its toxin.

Difficulties and dangers to be considered in vaccinating or immunizing animals.—The results of the efforts that have been put forth during the last twenty years to secure control over the infectious diseases of animals show that for a few diseases there is a well-established natural basis for vaccination, but with others such a foundation does not appear to exist. The reasons for occasional failures in vaccination are not difficult to find. The analysis of the principles underlying vaccination shows that it means the establishing of immunity by the introduction into the body of non-lethal doses of virulent virus or the use of a virus that has been attenuated. It is not always easy or even possible to know the exact degree of virulence possessed by the vaccine, and again the resisting force of animals varies even in different individuals of the species. If the virulence is too great, or the resistance below the supposed normal, the vaccine may produce disease in excess of the amount required to establish immunity, and perhaps it may kill the animals it was intended to protect. This is a result that has been experienced. As vaccination rests on the production of artificial immunity, the extent to which it can be applied depends on the efficiency of methods to produce immunity in different diseases.

In deciding on the action to be taken in the presence of an infectious disease, the selection of a

vaccine should be guided by the fullest knowledge possible of the nature of the disease itself and the extent to which natural and acquired immunity against it exists or is made possible. The dangers in vaccination as applied especially to animals at large may be summarized as follows: (1) The vaccine may be too much attenuated, resulting in the failure to establish immunity. (2) The vaccine may be too strong (virulent) so that it will produce more disease than is desired, possibly causing fatal results. (3) The attenuated virus of which the vaccine consists may regain its virulence. The distribution of living pathogenic microörganisms among animals is of itself not to be recommended. They may be the starting point of subsequent outbreaks. (4) In using non-lethal doses of virulent virus, the danger of producing fatal results because of the susceptibility of the individual treated is always present. Prevention, or the keeping of these diseases away from healthy animals, is by far the most effective method of protecting our herds.

Disinfection.

By disinfection is meant the destruction of disease-producing microörganisms. For this purpose, nature has provided very important agents, such as sunlight and drying, but these are not available or sufficient to destroy all infecting bacteria in all infected places within the necessary time limits. To supplement these natural forces, a large number of chemical substances have been brought into service. In the effort to destroy the microörganisms in such places as yards, stables, cattle cars and the like, it is necessary to consider before applying a disinfectant, the following conditions: (1) The resistance of the particular organism to be destroyed. (2) The medium or material in which it exists. (3) The nature of the place containing the organisms to be destroyed. (4) The chemical action of the material surrounding the microörganisms on the disinfectant itself. For the disinfection of pens, stables, floors and the like, the following solutions have been recommended, and with careful and intelligent use will be effective: (1) Corrosive sublimate (mercuric chlorid), one ounce in eight gallons of water (one-tenth of 1 per cent). The water should be put into wooden tubs or barrels, and the powdered sublimate added to it. The whole must be allowed to stand for twenty-four hours, so as to give the sublimate an opportunity to become entirely dissolved. Since this solution is poisonous, it should be kept covered and well guarded. It may be applied with a broom or mop, and should be used freely on all woodwork. Since it loses its virtue in proportion to the amount of dirt present, all manure and other dirt should be removed before applying it. The manure should be covered with lime or burned. Its very poisonous nature for man and animals renders it less desirable for general use than some other solutions. (2) Carbolic acid. A 5 per cent solution of carbolic acid is one of the best disinfectants for mangers, feed boxes and fixed watering basins. It should be applied in quantity sufficient thoroughly to wet all parts, and soak deep into the cracks and crevices, if there are any. (3) Chlorinated lime. Five ounces of chlorid of lime to a gallon of water (4 per cent). This should be applied in the same way as the corrosive sublimate. (4) Formalin. Formalin is being recommended highly as a disinfectant when used in a 5 per cent solution. The floors and walls should be thoroughly wet with it. (5) Ordinary slaked lime. Although it does not possess the disinfecting power of the substances given above, slaked lime is nevertheless very useful. It is well adapted for disinfecting the surface of yards and pens. It is very useful to apply to the ceilings and walls of stables. There are a number of other substances that may be used. In disinfecting stables and pens, all litter which has accumulated should be removed before applying the disinfectant. As the litter itself is infected, it should be burned.

SOME DETAILS OF STOCK MANAGEMENT

By *N. S. Mayo* and *H. W. Mumford*

Success or failure in breeding or handling farm stock depends very largely on the care and attention that is given to the animals to keep them in a healthy condition. Farm animals are kept under conditions more or less artificial, and these conditions are largely under the control of man. Whenever large numbers of animals are gathered together, the danger of loss from disease is increased and extra hygienic precautions must be taken for their protection. The laws of hygiene for domestic animals follow closely those of the human race, and in case of doubt, it is always well to "put yourself in the animal's place."

Increased traffic in farm stock also tends to increase the danger of loss from disease, not only because of the greater liability to infection from contagious disease, but the change in food and surroundings, together with the increased physical strain on animals incident to shipping, is likely to predispose them to disease.

When animals are exhausted from severe work or shipping they should always be allowed to rest before receiving the usual amount of food or water. The best practice is to give a little fresh water and a small quantity of easily digested food. Horses should be rubbed down, and all animals should be allowed to rest for a few hours, if possible, and then fed sparingly. Before shipping animals or subjecting them to severe work they should also be fed sparingly. It is mistaken kindness to feed animals heavily just before or during temporary severe work.

Quarantine.

All stock-farms should be provided with suitable quarantine quarters where recently arrived stock may be cared for until the danger of introducing contagious diseases by this means is passed. This is particularly important with swine and on stock-farms from which animals are exhibited at public fairs or shows. Quarantine quarters should be at a safe distance from other animals and so con-

structed that they can easily be cleaned and disinfected.

The stable.

Barns or stables are usually needed to protect animals against rigors of climate. They should be on well-drained soil, never over manure pits, of simple construction, that they may be easily kept clean, well lighted and well ventilated. Animals that are confined in stables should have plenty of room. Avoid placing a large number of animals together, as they do not do so well as when separated in smaller numbers. This is particuarly true of swine and chickens. For these animals it is better to use small portable houses that can be moved to new locations, and to keep only a small number in each.

Cement is now used extensively in stable construction. For horse-stable floors it is too slippery and too hard for the horses to stand on when they are kept much of the time in stables. Animals should always have clean, dry floors.

Stables should be cleaned carefully daily, and disinfected thoroughly at least twice during the winter season, and always after a case of disease among the animals in the stable. For disinfecting, a 5 per cent solution of carbolic acid (poisonous) in water is good (one part of acid mixed with twenty parts of water).

Bedding.—Animals confined in stables at night should have sufficient bedding to make them comfortable and to keep them clean and dry. Horses that are not well bedded are likely to develop "shoe-boils" from lying on their front feet, which they double under themselves to protect their bodies from the floor. Clean straw, coarse hay, shavings, peat-moss, and tan-bark make good bedding. The bedding should be free from chemical substances that will injure the skin or feet. The bedding should be removed from the stalls every morning and exposed to the sunlight and air during the day.

The bedding should be evenly distributed in the stall the last thing at night. Sufficient bedding should be used to make the animal comfortable, but an excess is to be avoided as the animal is liable to get in a bunch of it and become "cast," or unable to rise without assistance. When animals are required to stand on hard floors of brick or cement, their feet can be protected by using bedding in the stall during the day.

Lighting stables.—Stables should be well lighted and so arranged that the light will not strike the animals directly in the eyes. Light is best admitted from above and behind the animal. An excellent method of admitting light is by means of the Sherringham window shown in Fig. 127. This window is hinged at the bottom and opens inward at the top, and serves for ventilation as well as light. Abundance of light for stables is important hygienically, as direct sunlight destroys many germs, is a strong drying agent, and adds a cheerfulness that is greatly to be desired.

Ventilation.—Ventilation of stables is important. It consists in supplying fresh air to the animals, and at the same time removing air that has been breathed, and other gases and waste material that may be thrown off by the animal body or arise from the surroundings. Stables for horses and cattle should be so constructed that each animal may have 1000 cubic feet of air space if possible. Fresh air should be supplied and the impure air removed at the rate of 5000 cubic feet per hour. The more air space and fresh air that can be supplied the better, provided the animal does not suffer from draughts or cold.

There are two general methods of ventilation: (1) artificial, in which mechanical blowers or artificial heat is applied, and (2) natural, in which only tubes or openings are provided to supply the pure and carry away the impure air. (Fig. 128.) Whatever method is employed, no draughts should be allowed to strike the animals.

There are several methods of natural ventilation desirable for stables. In general, the fresh air is admitted through tubes between the studding, beneath the floor, or by means of the Sherringham window before described. The impure air is conducted through shafts to cupolas or cowls on the roof. Air shafts should be of good size, as straight as possible, and without right angles, and arranged so that they can be partially closed in severe weather. They should be kept free from cobwebs and other impediments. [See discussion in Chapter VII, Vol. I.]

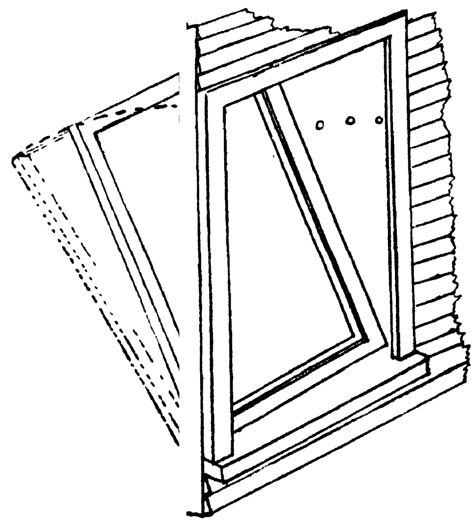

Fig. 127. Sherringham window from outside.

In the winter season, during the warm part of the day, it is good practice to remove the animals from the stable while it is being cleaned, opening all the doors, windows and ventilators that the dust and impurities may be removed and the stables well aired.

Water for animals.—Individual drinking basins in stalls are likely to become filled with food and water. The water soon becomes stale and unattractive. It is generally more satisfactory to have the watering tank outside the individual stalls. The water should be pure and fresh and the tank

cleaned frequently. Ailing animals should be isolated and watered from individual pails. Public drinking fountains should be avoided as far as possible, as some diseases, such as glanders and dis-

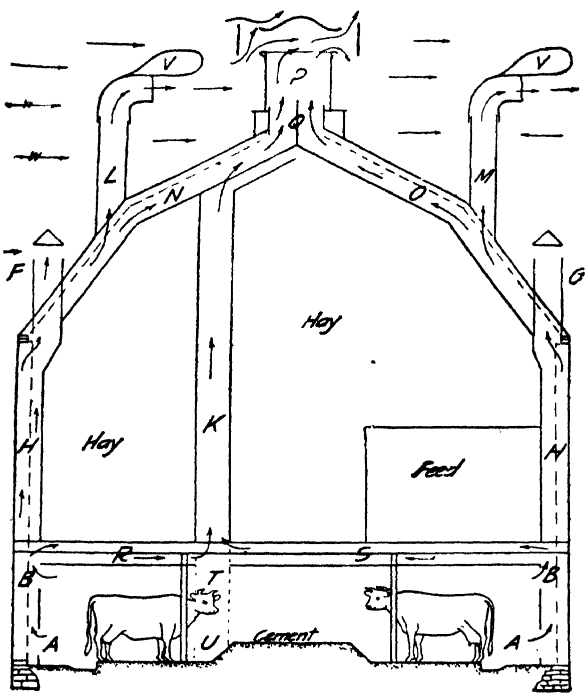

Fig. 128. System of stable ventilation. After King.

temper of horses and tuberculosis of cattle, are transmitted by this medium.

Exercise.

Exercise is essential to the healthy development and maintenance of animals. It stimulates and strengthens the different organs and this tends to keep the animals in vigorous condition, and to prevent disease. Stables should be provided with yards, protected from the cold winds of winter and the hot sun of summer, where animals can be exercised. Animals that are being fattened for market should have only sufficient exercise to keep the bodily functions regular.

Blanketing.

If a horse is allowed to stand on the street in cold or windy weather, he should be covered with a heavy blanket immediately on stopping, although he may be sweating. If he is brought to the stable in a sweaty condition, he should not be blanketed until he has ceased to steam, provided he is protected, otherwise the blanket and hair will remain damp. The substitution of a dry blanket two hours later will partly obviate this difficulty. Steaming should cease in fifteen to twenty minutes.

The stable blanket should be lighter and smaller than the street blanket. In hot weather, stable blankets are not needed except as a protection from flies. The early fall use of stable blankets may obviate the need of clipping the horse. After clipping, for a time both stable and street blankets should be warmer and heavier. Blankets should be securely fastened about the animal.

Handling. (H. W. Mumford.)

The quietness of manner of the attendant is an important consideration in the handling of animals. The even-tempered attendant who is quiet in manner and movement invariably proves more satisfactory than the erratic, bustling, noisy one. Domestic animals soon learn to have confidence in the former and welcome his coming among them, while they are always suspicious of the latter, never feeling quite at ease while he is in sight. This is especially noticeable in fattening cattle. Under the management of the former, the cattle become tame and quiet, even though more or less wild at the outset; while under the latter, wild cattle become wilder and tame cattle become timid.

The writer has observed a wide difference in practice among feeders as to their manner of approaching fattening steers. Some are brusque in manner, rushing up to the steers and scaring them up quickly, while others (and the more successful feeders) approach the cattle with the greatest care and consideration, getting the cattle up, if at all, as quietly as possible. Pastures for cattle in quiet, secluded places are more valuable for fattening animals than are those adjacent to public roads or adjoining pastures where horses or breeding cattle run.

Grooming.

Horses and cattle that are stabled should be groomed frequently, as grooming removes the dirt, increases the circulation of blood in the skin and favors the removal of waste matter from the body, improves the coat, and promotes the general health of the animal. Grooming is best accomplished by using a comb lightly to remove the attached dirt and afterwards brushing vigorously with a stiff bristle brush, then wiping the loose dust with a cloth. There is no one thing that adds more to the appearance of horses and cattle than thorough grooming.

Clipping horses.

If horses are protected by light stable blankets while in the stable and by street blankets when out in severe weather, clipping is desirable. It improves the appearance of the horse and his coat is more easily kept clean. Horses with long thick coats should be clipped, as the heavy coats hold the sweat and the animal may take cold when standing. It should be done soon after the full coat is grown, so that the hair may grow a little before severe weather comes on; and a second clipping should be given in the spring when the weather begins to get warm and the coat begins to be shed. When horses cannot be protected from the cold, either in the stable or outside, they should not be clipped in the fall; but the long hair on the legs, as far as the knee and hock, may be removed, as this will prevent those diseases of irritation of

horses that work in muddy places, due to irritation from mud and dirt.

Care of feet, and shoeing horses.

The feet of horses should be examined every day, and all dirt removed and the sole of the foot carefully examined for nails or other foreign bodies that may lodge there. In cases of sudden lameness, always examine the foot thoroughly for such objects. The hoofs of animals should be kept level by using a rasp. When horses are shod, this is done by the blacksmith. If the hoofs are becoming hard and brittle they should be softened by applications of oil or hoof ointment. If they are ragged or tend to split, they should be rasped on the edges and trimmed smooth. The hoofs of animals standing much in the stall frequently become of an excessive length and must be carefully trimmed. Attention must be given to the hoofs of young animals to see that they develop symmetrically.

Shoes are applied to the feet of animals to prevent too rapid wearing away of the hoof and injury to the sensitive tissues beneath. They are also applied to afford a grip on slippery streets, to impart action to roadsters, to change the gait, or to remedy diseased conditions. It is not necessary to shoe horses doing farm work on soft ground. Whenever horses show tenderness when driven on hard roads they should be shod.

Horses that are kept shod most of the year should have the shoes removed for a month or six weeks, if possible, and be placed on moderately soft ground in order to allow the hoof to expand and assume its natural condition.

For ordinary wear, a plain "plate" shoe without calks and just heavy enough to carry the animal's weight is sufficient. For slippery work or icy weather, calks are a necessity. Shoes should be reset every four to six weeks. In shoeing horses, the sole or frog should not be pared away, only the loose pieces of horn being removed.

Customary surgical practices.

Castration.—Castration consists in the destruction or removal of the testicles, the essential organs of generation in males. When male birds are castrated the operation is called caponizing, and the castrated bird is called a capon. When male domestic animals are castrated at an early age, as is customary, the following names are commonly applied to them. Castrated horses are geldings; cattle, steers; sheep, wethers; swine, barrows. When a mature animal is castrated he is sometimes called a "stag," because the masculine characteristics are often pronounced. A "ridgling" is a colt or horse in which only one testicle has descended into the scrotum, the other being retained in the abdominal cavity or inguinal ring. An expert veterinary surgeon should be employed to castrate ridglings, and also for colts or pigs that are suffering from inguinal herniæ, as a special operation is required.

Animals are castrated to prevent their breeding, to make them quieter and easier to handle. Castrated animals as a rule fatten easier, and the meat is of better quality. Domestic animals, generally, should be castrated while young, as young animals do not suffer so severely from the operation. As a rule, calves, lambs and pigs should be castrated when about three months old. Colts are generally castrated either as yearlings or two-year-olds. If a colt is not well developed it is best to wait until the spring it is two years old. There is more risk in castrating colts than other animals because of the greater susceptibility of colts to wound infection. Animals that are suffering from any debilitating disease should not be castrated until they have recovered their normal condition. Avoid castrating animals during severe weather, either hot or cold, or when flies are annoying. An excellent time is in spring, when grass is good. Before attempting to castrate an animal it should be carefully examined to be sure that it is in normal condition. Select a clean place for the operation, as free as possible from dirt and dust.

Colts and bulls may be castrated in a standing position by an expert, but under ordinary conditions the animal should be cast and securely tied, or, in case of small animals, securely held by an assistant. In all cases, the hind feet are drawn forward, and as high up on the shoulders as possible. In castrating colts, the hands, instruments and parts near the operation should be cleaned and disinfected. The scrotum should be washed with soap and water and afterward disinfected with a 5 per cent solution of carbolic acid. The operator grasps the scrotum firmly below the testicles, pressing them against the skin. If one is smaller than the other, remove it first. The incision should be made about one-half inch from, and parallel to the median line (raphe) that divides the scrotum, and well forward. The incision should be made of good size to admit of free drainage. Do not try to squeeze the testicles out through a small opening. There are three layers to be cut through—the skin, some white fibrous tissue, and the inner thin transparent

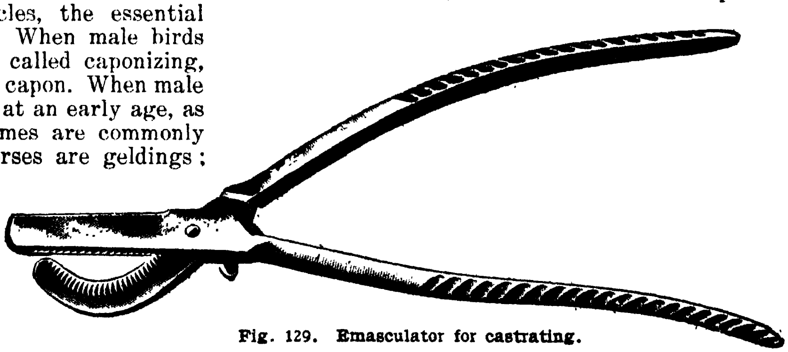

Fig. 129. Emasculator for castrating.

sack that covers the testicle. When the latter is cut through, a little watery fluid usually escapes. Avoid cutting the testicle if possible. The testicle is drawn out and removed, and the "cord" severed at least five inches from the testicle by an instrument called an emasculator. (Fig. 129.)

This is the best and quickest method for ordinary castration. The immediate danger in severing the "cord" is severe bleeding from the large artery it contains, and for this reason it is necessary to use some method to prevent it. The instrument mentioned crushes the artery so that it does not bleed. Another good instrument is an ecraseur (Fig. 130). Or the cord can be twisted off, seared with a hot iron, or scraped in two with a dull knife. The old method of using clamps on the cord is not to be recommended except in special cases.

Fig. 130. Ecraseur for caponizing.

In castrating calves and lambs, instead of making two separate incisions the whole end of the scrotum may be cut off, and the testicles drawn well down and cut off, as there is little danger of bleeding in small animals. After the operation the animal should rest for a time and then have some exercise, as this assists in removing blood-clots that may collect in the scrotum.

The important points to be noted in castrating are cleanliness, a free incision close to the median line and well forward, removing the testicles well up, and keeping the wound clean and free from blood-clots. After the operation all animals should be watched carefully to avoid the collection of blood or pus in the scrotum and the attacks of screw flies or common "blow" flies. Should pus collect in the scrotum, it should be carefully washed out with boiled warm water, and afterwards disinfected with a 3 per cent solution of carbolic acid in water, using a syringe for the purpose.

In colts there is often considerable swelling of the sheath and adjacent parts. The animal should have exercise, and once daily for two or three days should be given a heaping teaspoonful of saltpeter dissolved in water and applied as a drench.

Sometimes in colts and pigs, when the "cord" is left too long, it becomes attached to the tissues of the scrotum and a tumor forms, commonly called "Shrirrons' cord." This must be removed surgically in the same way as castration. It is best to employ an expert veterinary surgeon for this work. Tetanus or "lockjaw," peritonitis and "blood poisoning" sometimes follow castration.

Caponizing.—Capons, as a rule, weigh about one-third more than cockerels, fatten more readily, and the flesh is of better quality. The best age to caponize is when the bird is six to eight weeks old. [See *Capons and Caponizing*, under Poultry.]

Spaying.—The castration of females consists in the removal of the ovaries. The operation is called spaying and the animal after the operation is said to be spayed. In spaying animals it is necessary to make an opening into the abdominal cavity and remove the ovaries. In cows and mares that have borne young the operation can be performed through the vagina, but in heifers, sows and bitches an incision has to be made through the abdominal walls in the region of the flank or abdomen. An expert veterinary surgeon should be employed.

Docking lambs.—The tails are usually cut off when lambs are about two weeks old. The sooner lambs are docked after birth the better. They should not be docked, however, before they are strong, or until they are at least two weeks of age. A strong knife should be used. The skin of the tail should be drawn towards the body and the tail severed at a joint, if possible, about one inch from the body. It is well to have a hot iron convenient and touch the end of the artery when there is much bleeding, but as a rule it is not necessary. A small amount of pine tar may be daubed on the stump. The lambs should be examined frequently to see that larvæ of flies do not get into the wound. Should this occur, some chloroform should be applied, which kills the larvæ at once, and the wound should be treated with antiseptics.

Docking horses.—Docking horses by cutting off the tail, except for disease or to overcome a vice, is a useless and cruel practice, and is not to be recommended. It is a fashion that at best is but temporary.

Dehorning.—Cattle are dehorned to prevent their injuring persons or other animals; they are then more tractable and feed better. There are two general methods of dehorning: (1) By destroying the budding horn in calves. This is usually done by applying caustic to the "button" as soon as it can be felt beneath the skin of the head. Clip the hair away over the budding horn and moisten an area as large as a cent. With a stick of caustic potash wrapped in paper to protect the fingers, rub the moistened area thoroughly over the whole button. Care should be exercised that the part is not too wet so that the caustic will run over the skin. In a week a thick scab will drop off. If the operation was done properly the horns will not grow. It is not practicable to remove with caustic budding horns that have pushed through the skin. The budding horns of calves may also be removed by using a gouge, a special instrument being made for this purpose.

(2) Range cattle are usually dehorned when they are put in the feed-yards to fatten. It is best not to dehorn them when they are first brought to the feed-yards, as it makes them very timid, but to wait until they are started on feed and accustomed to their surroundings. The adult animal is confined in a chute made for the purpose, although a strong stanchion can be used. A halter is put on and the animal's head is drawn far toward the side. The horns are removed either with a dehorning saw or with clippers made for the purpose. A good ring of hair should be taken off with the base of the horn as the wound heals better, there is less bleeding and no stub horn grows out again. A dehorning saw does better work surgically, but it is slower and more painful to the animal.

After removing the horn some pine tar may be daubed over the wound and a small piece of absorbent cotton stuck on to keep out the dirt. Dehorned cattle should not be allowed about stacks until the wounds have healed, as they are likely to get chaff and dirt in the wounds.

Cattle suffer little from dehorning, and it is

seldom that an animal misses a meal. Milch cows fall off in their milk flow a little for a day or two.

Branding and marking stock (W. T. McDonald).

On the ranges, the calves and colts are branded in the fall of the year. Each owner has a particular branding-iron, usually representing one or more letters. This branding-iron is generally heated in an open wood fire. The animals are roped or held in a frame, and the brand is burned on the side. Each owner brands in a particular place; for example, on the right or left shoulder, or on the right or left thigh. Horses are sometimes branded on the cheek by a small-sized branding-iron.

When stock-raising is practiced on a smaller scale, cattle, hogs and sheep are marked by metal ear-tags or by notching the ears. In this way each animal has a number of its own, which facilitates the keeping of individual records. When the ears are notched the following method, or a modification of it, gives excellent satisfaction: Each notch on the lower side of the left ear counts 1; each notch in the upper side of the left ear counts 3; one notch in the tip of the left ear counts 100; one hole punched near the tip of the left ear counts 400; one hole punched near the lower side of the left ear counts 1,000; each notch in the lower side of the right ear counts 10; each notch in the upper side of the right ear counts 30; one notch in the tip of the right ear counts 200; one hole punched near the tip of the right ear counts 500. By this method, each animal may be given an individual number. The greatest objection to it is that it disfigures the ear somewhat.

Sometimes horses are numbered individually by branding a number on the front of one of the fore hoofs. For this purpose, a brand-holder in which the desired number is placed, is used, the iron figures being one-half or three-quarters of an inch in height. This number has to be renewed as the hoof grows out.

Sheep are frequently marked on the fleece by paint or keel.

Preparing cattle for shipment (H. W. Mumford).

There are shippers who, by divers practices, have secured an abnormal "fill" at the market, or, in other words, have been successful in making their cattle weigh more than they should by inducing them to drink an unusual amount of water when they reach the market. It should not be forgotten that there are past masters of the "filling" process at all our leading markets, and many of them operate outside the fat cattle division, too. The trained eye for fat cattle is always on the lookout for cattle that have "filled" unusually well, and when he sets the price on such he is sure to discriminate against them in value per hundredweight, as he knows there will be a heavy shrinkage when slaughtered. Any practice which tends toward securing an abnormal "fill" on cattle at the yards is neither a legitimate practice nor is it likely, in the long run, to prove a paying proposition for the shipper. On the other hand, it is well known that unless some precautions are taken before shipment, the cattle are likely to scour and shrink abnormally. The shipper is justified, therefore, in using legitimate methods of preventing scours, not only to avoid an abnormal shrinkage, but also to prevent the cattle arriving at the market in a filthy condition, which would not add to their attractiveness.

It may have been inferred from what has been said that the principal point to be observed in shipping cattle without too much shrinkage is to follow some peculiar method of feeding; but the writer thinks that the largest factor is the management of the cattle. They should be so quietly handled that they do not become excited or heated. If possible, driving should be done in the cool of the morning or evening. There are some feeds, which, if the cattle have access to them prior to shipment, will be more likely to cause scours than others. These are shelled corn, corn meal, oil meal, silage, clover hay, alfalfa, cowpea hay and grass. Cattle that are fattened on grass and grain during the early part of the season may well be yarded for a day or two before shipment and fed timothy hay and a considerably reduced grain ration. Fat cattle shipped from the dry lot, if receiving clover or alfalfa for roughage, should be changed to timothy hay at least twenty-four hours before shipment. No full grain ration should be given after twelve hours before shipment, although it is advisable at times, and especially if the cattle have been fattened on shelled corn or meal, to add a liberal amount of oats or bran to the feed. Water should be withheld for six hours before shipment.

If, in addition to the above precautions, care is taken to bed the car well and not overload, the cattle should arrive on the market fresh and clean and will fill normally, which should be the object of the shipper. Cattle so shipped should make honest weights for the producer and buyer and healthy meat for the consumer.

It is obvious that the management of cattle before shipment will necessarily vary considerably not only because of differences in their condition, and the rations on which they have been fed, but also the distance from market and the time they will be on the road, and whether it is necessary to unload and feed enroute. Some of the suggestions offered will apply only to the preparation of cattle for shipment when they are not to be on the road to exceed twelve hours. [For additional notes, see *Marketing Farm Stock*, pp. 158–162.]

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CHAPTER VI

THE EXHIBITING OF ANIMALS

EXHIBITIONS HAVE A POWERFUL INFLUENCE on the domestic animals of any region. They set standards, and persons attempt to attain to these standards. The nature of the standards established at the shows, therefore, becomes a subject of the first importance to any agricultural people.

Exhibition standards are of two kinds,—those based on "show" points, and those based on "utility" points. The show points consider the "looks" of the animal. They are likely to be arbitrary and to be subject to changes in taste and fashion. For some years, for example, it has been the fashion to require that prize-winning Shropshire sheep shall have the face covered with wool. The wattles and combs of fowls are prominent subjects of "fancy" points in judging. Such classes of ideals may not only have no significance, but they may even be in opposition to the real value of the animal; yet, they determine the line of breeding of the persons who may be regarded as the leaders in the development of the breed. Some of the arbitrary points, however, are distinctive features or marks of breeds, as color, and shape of individual parts. The utility points are those that represent efficiency—the form and size of the "leg of mutton" in a sheep, the milk-producing power in a cow, the egg-laying ability in a fowl, the "constitution" in any animal. Sometimes the show points coincide with the utility points, or they correlate with them. Thus the general form or looks of a sheep may indicate his constitution and hardihood. In the past, the exhibitions have no doubt often over-emphasized the formal and unrelated points; we are now giving more attention to the marks and conformation that indicate what the animal can do, and this is likely to have considerable influence in the future development of breeds.

Another fault of the exhibitions, particularly in America, is the lack of a real educational impulse. The show is conducted for the benefit of the exhibitor rather than for the benefit of the public. An exhibitor usually is allowed to keep his cows or other animals all together, even though they are of very different classes, and he is not obliged to adopt any system of labeling and cataloguing that will interest and instruct the spectator. The shows of Great Britain excel in the educational features, and they are better organized and conducted than ours. They are more careful to eliminate mediocre animals; they group each breed or class by itself, irrespective of exhibitor, thus encouraging comparison and study; entries are carefully catalogued and numbered, and they are admitted far enough in advance to allow this to be done with care; visitors are excluded from the ring when the judging is in progress; the stalls are usually better arranged to allow of examining the animals, being commodious and well lighted, and strict stable rules are enforced.

The leading American shows are noted for their bigness. The first-class animals are probably as good as those to be seen anywhere in the world; but indifferent or even inferior animals may also be shown, thus reducing the average standard of excellence. The judges are likely to be annoyed by bystanders and interested persons. The money prizes are often large in the American shows; this feature attracts many small exhibitors, who have meritorious animals, but who might not otherwise be able to show, thus encouraging a wide-spread effort. On the other hand, there is a marked tendency to offer such classes of premiums, in many of the fairs, as to attract traveling professional exhibitors to the exclusion of individual agricultural growers. There is a certain professionalism in American shows that should be eliminated. This is produced of the desire to win. The professional exhibitor scours the country for a string of winners. When the small breeder finds that he cannot win against a man who buys animals for the sole purpose of exhibiting them, he loses interest in exhibitions and leaves his stock at home. This can be remedied by not catering to this class of persons in the premium lists, and by requiring that all exhibitors shall have bred their animals or else have owned them and had them in possession for six months or more preceding the exhibition.

The American show is likely to contain many extraneous amusement and entertainment features, and therefore to lack the serious aim and effect that makes for a real admiration of excellence in superior animals. We must establish ideals. It is one thing merely to mate animals, and then feed them for the production of meat or milk or wool; it is another thing to produce animals of more perfect function, utility, form or symmetry than those with which one started.

The American live-stock shows can no doubt be much improved, speaking broadly, by some or all of the following means: (1) By subordinating the exhibitor to the animals; (2) by preventing the exhibiting of all inferior animals; (3) by providing better stall or stable facilities, and making and enforcing uniform stabling regulations; (4) by placing together all animals of similar classes; (5) by numbering the stalls, and printing a catalogue with corresponding numbers, and with information as to breed, class, age, weight, ownership, sire and dam, and the like; (6) by excluding all onlookers and interested parties, if need be, until the judging is completed; (7) by designating every prize-winning animal, and arranging the animals in the order of their standing, so that the visitor may know at once the rating of the animals on exhibition; (8) by an effort to make the animals the chief attraction of the show. All this means that the purpose of the show should be broadly educational; and this is really the primary reason for making any exhibition that is not frankly a market emporium.

A recent feature of American stock-shows is the judging by competing groups of students from the agricultural colleges. This innovation is commendable, and it is likely to give definiteness to the educational purpose of an exhibition.

FITTING AND EXHIBITING LIVE-STOCK

By *C. S. Plumb*

In general, two classes of persons make a practice of exhibiting live-stock: One shows pure-bred breeding-stock; another, butcher's stock, such as steers, wethers or barrows, or grade market horses. Most growers exhibit, appreciating the opportunity as a valuable advertising medium. Others have a keen enjoyment in following the show circuit and participating in its excitements and inspirations. In the show ring the true stockman draws many comparisons to his own advantage and learns many lessons from others to help him to still greater achievements. Numerous conditions play essential parts in successfully exhibiting live-stock. Some of the more important of these may be considered in the following paragraphs.

The type of stock to be shown.

Each person engaged in the exhibiting of animals in public competition must possess a fair knowledge of animal conformation. Without that, intelligent effort is impossible. With this knowledge one must plan to exhibit animals of uniform type and excellence. It is rather generally recognized today that our domestic animals, somewhat irrespective of breed, may be grouped into types of distinct character. Thus, we have the heavy harness and the draft types of horse; the beef and dairy types of cattle; the mutton and wool types of sheep; and the bacon and lard types of swine. There are also other types. Even within the breeds one will recognize types descending from certain blood lines organized or created by noted breeders. To exhibit stock successfully one must select his show animals to conform to the recognized approved type demanded in modern high-class competition. If one exhibits a herd, the same type should prevail among all the animals. This gives great strength in competition. Not only type as applied to form, should be emphasized, but a careful consideration of quality and color will be very desirable.

Fitting animals for exhibition. (Figs. 131–134.)

Each great group of animals requires special consideration in methods of fitting and preparing for show. There are certain things, however, that have a general application to all kinds of stock.

Feeding.—A variety of the best of food is essential. The standard grains,—corn, oats, barley and wheat,—and various by-products, such as bran, middlings, shorts, oil meal or oil cake, and ground flaxseed, are much relished. Bright hay (free of dust), green grass, roots, silage, cabbage, rape, and the like, are adapted to one class of stock or another. Horses require the least variety, but the food must be of a superior quality. A limited amount of oil meal or ground flaxseed is suited to all classes of stock and imparts a finish to the coat of hair and skin. Roots and green stuff may be fed with some liberality to cattle and sheep, and with much more discretion to horses and swine. Rape and cabbage are especially suited to sheep. New milk is invaluable in fitting young cattle up to twelve or fifteen months of age, while pigs at any age will rapidly respond in gain and quality on a partial milk diet. In recent years, digester tankage and blood meal have been found to be valuable aids in fitting show swine. Salt should be fed regularly to all stock. Many stockmen mix a small amount of salt in the feed. Tonics of various kinds, as eggs, sugar, molasses, and the like, are used under varying conditions and kinds of stock. These may or may not be used profitably. When forcing is desired, these unusual foods are supplied in small amount to increase the appetite and the food consumption.

The mechanical condition of the food is important. Chaffed hay mixed with grain and dampened is very palatable. Sliced roots or silage mixed with this chaffed material is very appetizing for cattle and sheep.

Regularity of feeding is important, Fattening animals may be finished off more rapidly if the feeding period is more frequent than usual, as for example, four times daily instead of twice. Feed-boxes and mangers should be kept sweet and clean, and scalded out at frequent intervals. All food left in the manger should be cast aside at the next feeding and only fresh food given. Animals in proper digestion should clean up the manger in good shape some time previous to the next feeding. Watering should be regular and only clean, pure water provided.

Skin and hair treatment.—A mellow skin and a silky, fine coat of hair is very desirable. Occasional massage of a thick and tight hide of an animal will cause it to become more elastic. Sweet-oil rubbed into the skin will help. Flaxseed meal in the feed will improve both skin and hair. Black hogs at show time are often colored with a mixture of lampblack and oil. It is objectionable, however, to make this application excepting in a very moderate way. Too deep a black on a Berkshire gives it an unnatural coloring. Grooming of horses and cattle should always be done with brush and cloth. The skin should not be scratched. For swine, a

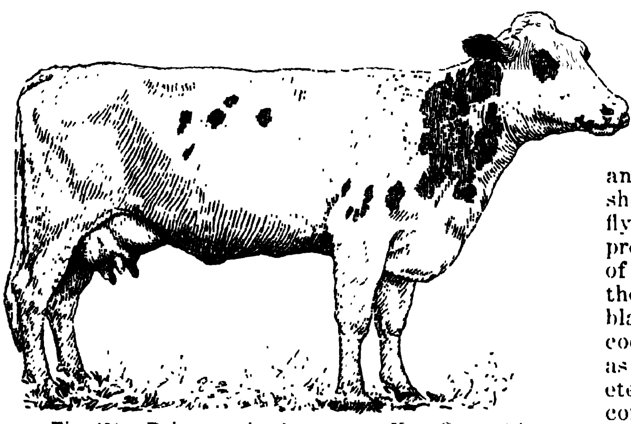

Fig. 131. Dairy cow in show pose. Kate Spray 4th. First prize in class at Ohio State Fair. Holstein

reed or rush brush is most excellent. In the later stages of fitting, horses, cattle and swine may be occasionally washed with water of ordinary temperature, and the skin cleaned of dirt and dandruff. It is undesirable, however, to remove the natural oily secretion of the skin.

Cattle are shown in some instances with a smooth coat of hair (Fig. 131), while with other cases it is rough and long, as with the Galloway. An animal with a long, thick, silky coat may be shown rough to great advantage. In recent years, in the fall shows, the hair of cattle in some breeds is soaped to make it stick together, after which a comb is used to give the coat a wavy or fluted appearance of a fancy character (Fig. 132).

The wool of sheep is given a final trimming just prior to showing. (Fig. 133.) The wool of the Merino is not trimmed with the shears, but that of the middle wool is blocked out, trimming to secure level true lines on back and sides, with graceful curves about the head, neck, breast and hind quarters. It is a general practice to trim the fleece so that it will accord with an ideal mutton form

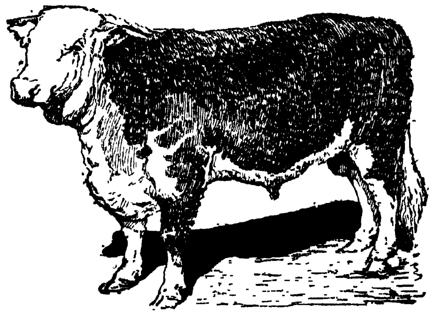

Fig. 132. A well-trained calf in perfect show pose. Matchless Theodore. (C A Stannard.) Hereford.

beneath. Care should be taken to keep the fleece as close together in its locks as possible, especially over the back; and care is required in feeding roughage and scattering bedding, so as to get no foreign matter in the wool. Some men use a slight amount of yellow coloring in the wool, but this is undesirable. A custom which once prevailed, but which is now rarely followed in America, is to apply a light dressing of reddish or brownish ocher and oil to the exterior of the fleece. This was done to give uniformity of appearance to the wool of the flock shown.

Blanketing of show stock is coming into less and less favor. All classes of stock intended for show may be blanketed to some advantage during fly season. In general, however, most exhibitors now prefer a coat of hair free from the heating effect of the blanket. Cattle with rough, long hair have the real rugged, artistic show of coat injured by blanketing. Animals exposed to drafts in the cooler days while on the circuit, may be blanketed as a protection from colds. Sheep are often blanketed to protect the fleece from foreign matter, to compact the locks, and to keep persons from sticking their fingers into it. Blankets may be purchased ready made, or may be made of white duck,

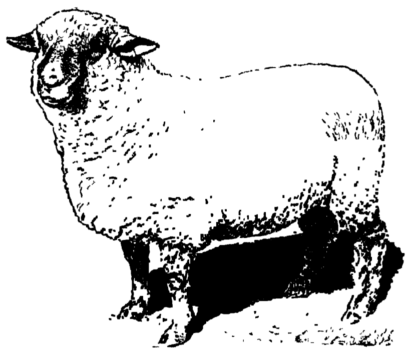

Fig. 133. A beautifully blocked out fleece. Hampshire ram.

bed ticking, or burlap. The points of tying, by sewed-on tape or string, are below the neck and about the belly as a surcingle. With sheep and

cattle, ties are made about the thighs. Such fastenings keep the blankets in place.

Horns and hoofs should be shaped and polished. A half-round file, moderately coarse, will reduce the rough surface bone, while emery paper and some form of polishing paste and oil will result in a fine polish. Horns not taking on good form may be assisted in shaping by scraping the inner side, making the shell thinner. The hoofs of all classes of stock must be watched and kept trimmed so that the feet will stand level and true. Special trimming and shoeing of horses' hoofs are required, depending on action and show-ring purpose. Hoofs of horses are rubbed with sweet-oil prior to showing, and a bit of lampblack added when hoofs are treated. Great care should be taken to keep divided hoofs of cattle, sheep and swine from growing too long or out of balance in parts. The trimming of hoof resorted to should be very careful, else lameness will result. Gradual trimming is desirable, taking off no great amount of bone at a time.

Stabling.—Prior to going on the circuit, a variety of customs prevail in regard to the stabling. Show stock should be provided with box-stalls in the later weeks of fitting preceding the show. Here, more comfort is possible for securing the best results. Ample bedding, preferably of straw, should be given. Animals in box-stalls should not be disturbed when lying down within a short time after feeding. The after-feeding rest is valuable in securing gains with meat-producing stock. Horses do not come in this consideration. In summer, during fly season, cattle do better in a darkened box-stall during the day, and in feedlot or pasture at night, than out fighting flies in the sunlight. Hogs and sheep should be kept under limited yardage and pasture, convenient to shelter, and should be kept up during the heat of the day, in clean, bedded yards or pens.

Exercise is most important with all kinds of show stock. This may be secured in a variety of ways. Horses are given a warming-up exercise for perhaps fifteen minutes; cattle are exercised by natural inclination, in yards or in small pastures; while most experienced exhibitors of sheep and swine drive their show stock about the yards or drives for a short time each day, to keep them well on their feet and so that they may move gracefully and easily. Exercise also assists in creating a firm flesh, which is most essential in show stock.

Training is an important preliminary treatment of animals that are to show off to advantage. A well-trained animal will stand at quiet attention while under the inspection of the judge, or will move up in free, natural action if movement is desired. Young animals easily respond to handling and training. By means of halter or bridle, leading is made easy and changes of position readily secured. The feet should stand true, so as to present the body in the best balanced position; one foot out of line with its mate may place the body in very poor form. By means of a slight touch of the point of an ordinary carriage whip or cane, one may train cattle and horses to move the foot to a desired point. Pulling or backing gently will also be quickly responded to by the trained animal. Horses, in particular, must be shown in action, even if of the draft type, so that special attention is absolutely necessary in training to produce the truest and best gait possible. Coach horses are sometimes shown under a long, single line, where action is brought out in its greatest beauty, with the body of the attendant at some distance behind. Horses, cattle and sheep, when not in motion, should always stand at attention while in the judging ring. Under such conditions, the attendant should never obstruct the view of the judge. A careful exhibitor will never lose sight of this point. Swine being shown loose in the ring, should respond to gentle taps of cane or short whip, without manifesting irritation. Light, short hurdles, convenient for one person to handle easily with one hand, are valuable in show rings to guide pigs from other groups, and prevent friction.

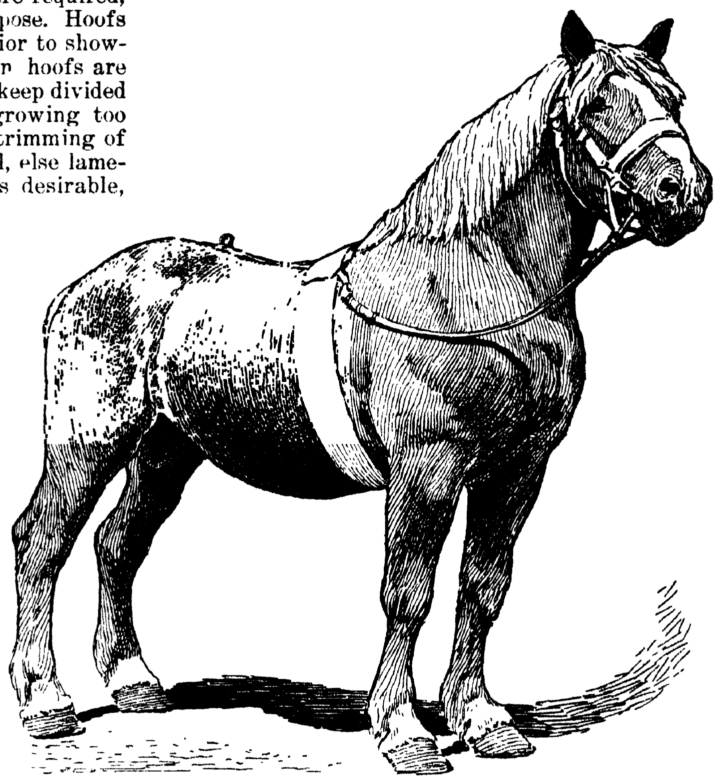

Fig. 134. Draft horse well shown. Note ring trappings.

Making entries.

All fairs and live-stock shows publish premium lists in which will be found books of entry. Entry

blanks are furnished by the secretaries on application. Entries must be made within a fixed date at all large shows. In most cases, entry fees are required, but in others, not. For example, the International Live-Stock Exposition charges no entrance fee, but charges a stall fee, which is much the same thing. Fees are generally required with the entry, though exceptions are made. Entry fees may range from fifty cents per head on sheep or swine, up to two or three dollars on horses or cattle. A fair example of rules of entry are the following, as applied in 1907 at the Ohio State Fair:

"All entries of animals must specify the owner's name and the name, age, sex, record number (if any) and description of every animal offered; ages of horses to date, from the first of January of the year foaled; ages of other animals except cattle to be considered in months and days at date of fair; ages of cattle to date from September 1, i. e., an animal coming two years old as late as September 1 is entitled to show as a yearling. A breeder is held to be the owner of the female at the time of service.

"Entries must be made in the name of *bona fide* owners. Should any be found to be otherwise entered, they will forfeit to the State Board of Agriculture any premiums awarded by the judges.

"An animal entered for exhibition in one class cannot compete for a premium in any other, except in speed classes and under rule 6; provided, however, that animals entered in Books Nos. 1 and 2 can be entered in Book No. 3.

"A single animal may be exhibited as one of a pair or herd.

"On receipt of entries of live-stock, cards will be made out indicating the books, entry numbers and classes, and will be ready for delivery by the superintendents of the appropriate departments when exhibitors arrive on the grounds, or will be sent by mail when specially requested."

Transportation (Figs. 135–139).

Animals exhibited at shows are usually transported by freight in box-cars or special live-stock cars. Exception is frequently made with horses, which are shipped in express cars. Persons desiring to ship should order cars a day or so in advance of need. The interior of the car may be arranged by the shipper with improvised box-stalls or pens to suit his convenience. A good method is to place horses or cattle in number, side by side, and facing the side of the car, with a narrow feed alley in front. With loads of cattle of minor ages, the heavier bulls and cows should be at the ends of the car. Five or six head, however, may be fastened to face the center of the car, with straw beneath burlap or cloth for padding on car walls to prevent bruising. The center of the car is reserved for a sleeping place, utensils and feed. In the cooler season it is often desirable to blanket cattle and horses in shipment, to protect them from drafts and catching cold. Sheep should always be blanketed to keep the wool clean. Baled hay and straw, under ordinary occasion, should be shipped. In long shipments, a barrel for holding water should be taken along.

Special freight rates for animals for shows, with free transportation for one attendant, have been customary in the past years in the United States. A common freight concession has been a one-fare freight rate for the round trip on cattle, sheep and swine. For example, if one ships to the state fair he prepays the freight, receives a bill of lading for the stock, receipted, showing the number and class of animals shipped, with name of attendant carried free, with certain other facts, such as name of shipper, to whom consigned and destination, number of car and freight rate. Exhibitors may ship a car of mixed stock or otherwise, as they desire. Representatives of railways and express companies, as a rule, are found at important shows, where they solicit business and attend to shipments. Cars containing exhibits are in many cases especially fixed up by exhibitors for their stock, and are side-tracked, subject to the further use of the shipper. In this way, the same car may be used on the show circuit, covering a long mileage of several weeks' duration. The use of such a car is a special convenience and saving of cost. Exhibitors wishing cars reserved should arrange at once, after unloading, with the local railway agent for reservation for their further use after the show is over.

Stalls and pens.

Stalls and pens at shows of importance are set aside to the exhibitors before the opening of the show; each stall is numbered and grouped. If John Brown arrives with a load of cattle, he is at once assigned certain stalls, by number, by the department superintendent. In some shows special stall tickets are issued the exhibitor for each entry. As before indicated, prices for stalls vary. At the Chicago Horse Show in 1904, stalls were ten dollars each, including straw. At the American Royal Live-Stock Show at Kansas City, in 1907, the following stall fees prevailed: "Rule 9. Stall fees will be three dollars per head for double stalls accommodating two animals, and when exhibitors desire a double stall for one animal the charge will be five dollars. A yardage charge of twenty-five cents per head will be made, except on nurse cows. In the swine department a charge of two dollars per pen will be made regardless of the number of animals in a pen." Box-stalls are provided at some of the larger shows, at about double open-stall rates.

Feeding and bedding.

Exhibitions vary greatly in their rules as to feed and bedding. Bedding should be supplied free by the management. All feed must be supplied by the owner of the stock, at his expense. In most cases, at large shows, feed dealers secure concessions to sell on the grounds; usually one person or firm controls this situation. The exhibitor may bring his feed with him or buy wherever he desires. In some of the great shows of the country, the exhibitor, by the rules, must purchase his feed at the show. This is to prevent storing among the stalls

a variety of litter and parcels, thus obstructing the passageways and views of the stock. Certain concentrated feeds are allowed to be brought in when a change would affect the welfare of the stock. Rule 49 of the International Live-Stock Exposition for 1907 treats of this as follows: "The superintendent of forage will have feed for all live-stock at reasonable prices. To prevent aisles being obstructed with feed and bedding, to preserve the general harmony, and that stock may be shown to the best possible advantage, exhibitors will not be allowed to bring hay, bedding or whole grain."

Exhibitor's cards.

Each person showing animals as single, double, pen or other entries, must secure from the secretary of the association entry cards for each exhibit. These cards or tags will give the class entry number of the exhibit, as based on the printed classification of premium list, also the number of the exhibitor and perhaps other facts. These cards must be in the hands of the exhibitor before his stock is called for in the ring. This rule generally applies to all shows, down to the well-managed county fair. If a person has two cows in the same class, he must have two properly filled-out entry cards for each cow. These, then, should check up with the class entry on the books of the clerk of that particular exhibit.

At some of the best shows in the country, catalogues of the live-stock are printed, giving the entry number in prominent type as a prefix to each exhibit. Then the attendant holding the stock in ring wears on his arms, or chest and back, large cards on which is a very legible number corresponding to the number of the entry in the catalogue. Visitors with catalogues may thus readily ascertain the character of the exhibit by the description published. Catalogues of the entries are published by the horse shows of importance, by the International Live-Stock Exposition, and by the Illinois State Fair. The catalogue and card system at the annual shows of the Royal Agricultural Society of England, and of the Highland and Agricultural Society Show of Scotland, are fine European examples of this worthy method. With large numbers tacked against each stall, or worn by the attendant, the owner of a catalogue is able to view the show to material advantage. It is to be regretted that this custom does not prevail at more of our important American shows.

Show-ring rules and methods.

In showing stock in the ring, one should present his animals under the best conditions possible. Each ring is usually in charge of a superintendent and clerk. One of these officials sends notices to exhibitors when to appear with stock of the classes desired. The usual premium list gives the day for exhibition, and the exhibitor should have his work well in hand and be ready with his stock on call. The attendants should be neatly dressed. Some shows, such as the International Live-Stock Exposition, endeavor to require a uniform. Many firms of importance, who show on an extensive scale, provide their attendants with neat uniforms. Slouchy attendants, with untidy, filthy dress, should not be permitted in the ring. Horses and cattle should be bridled or haltered with first-class furnishings for show purposes. Any advertising schemes about the ring are in bad form and should not be attempted.

Each exhibitor will line his stock in position as space is allowed or assigned him. It then becomes his duty to place his animals strictly on exhibition, that the judge may inspect at the very best advantage. This phase of the subject has already been somewhat discussed in the topic on training. A correct bearing of the animal and an attentive attendant add greatly to success in showing.

In the horse show certain rules prevail that are not applied to other stock. This may be illustrated in the following rules, applied at the Chicago Horse Show in 1904:

"All horses must be shown in the shoes in which they come to the show, and no horse's shoes may be changed, except for reasons satisfactory to the executive committee, and with their assent. The use of shoes of excessive thickness for the purpose of increasing the height of a horse will not be allowed, and a horse shod in this manner will be disqualified.

"All horses doctored in any way artificially, improperly, or unfairly prepared or tampered with before coming into the show-ring will be disqualified.

"No animal exhibited shall be decorated about the head with colors until after the awards are made in respective classes."

When cattle are shown in milk in the ring, the judges may order them milked out at their discretion. For years the custom has been to show dairy cows with heavily distended udders, from which the milk has not been removed for twenty-four to thirty-six hours. The custom is now coming into force in America to require exhibitors to milk the cows dry the night previous to showing, a representative of the show-yard inspecting to see whether the rule is obeyed. This is as it should be.

Exhibitors of pure-bred stock will be wise to carry with them at the show the certificates of registry of the animals shown. While demand for such paper is rarely made, competitors from time to time are responsible for a demand for them. By the rules of some breeding associations, pure-bred stock shown must be registered.

Non-breeding pure-bred stock, by the rules of many associations, is barred from the ring. For example, a certificate may also be required showing that a cow or horse three years old or over had produced a living offspring since September 1 of the year previous to showing, or give satisfactory evidence of being in calf or foal. Even bulls may be disqualified, for the International Live-Stock Exposition provides a rule whereby any bull over thirty-six months old, entered in any breeding class, that has not had dropped to his service a living calf during the eight months preceding the exposition, shall be deemed barren and be excluded from competition. Rules of this character often

apply to other classes of stock, and meet with the approval of stockmen generally.

The custom of parading and exhibiting stock in the ring is not general, but is sometimes employed, especially in the larger European shows, and in those of the United States in which large, covered pavilions make the management independent of the weather. The Illinois State Fair has a rule to this effect: "All competing animals shall be exhibited and paraded in the ring at the discretion of the superintendents, and any exhibitor failing to comply with this rule shall forfeit any premium awarded his stock."

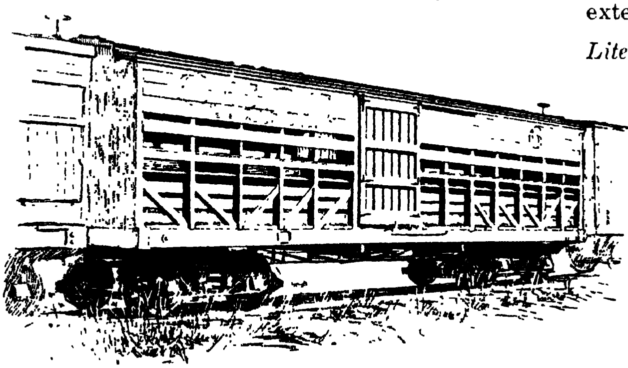

Fig. 135. Modern cattle car.

In order of showing, animals are first presented in what are known as classes. The following are examples of standard classes:

Cows three years old or over.
Cows two years old and under three.
Cows one year old and under two.
Calves under one year.

There may be other classes, as for example, senior and junior, heifers in milk and not in milk, and the like. In addition to classes, herd prizes, groups of sex, offspring of sire and dam, championship, sweepstakes, and the like, are offered.

Awards are usually made by the one judge system. Usually only the prize animals are placed, but occasionally the judge is required to place in relative order of merit each animal in class. Prizes range from two to five or even more.

Awards are usually indicated by colored ribbons or rosettes, and the standard relationship of color to award is as follows: Blue, first prize; red, second; white, third; yellow, fourth; and green, fifth. Royal purple applies to championship or sweepstakes. The ribbons are handed the attendant either by the judge or his clerk, and note of the award made on the clerk's entry book. After the awards, custom permits the withdrawal of the animals from the ring.

Premiums are usually in cash, although medals, cups, ribbons, certificates, and the like, are awarded. Premiums at many shows are paid before the exhibitor ships his stock away. Payment is made by bank check, payable on presentation to the office of the treasurer of the association. *Premiums not paid during the show will be paid by checks sent through the mail.*

This subject is one involving many details in the way of experience on the part of the stockman, but the space available here will not permit a more extended consideration.

Literature.

Clark, W. J., Fitting Sheep For Show Ring and Market, Chicago (1900).

MARKETING FARM STOCK

By *C. S. Plumb*

The marketing of farm stock may be conducted in several ways, but it is quite dependent on the class of animals to be disposed of. The old-fashioned method was to drive across country to market. The drives, in some cases, covered many hundred miles, as the famous overland ones from Ohio to Baltimore, or from the far Southwest to St. Louis or Chicago. The modern method is transportation by rail or by boat. In a limited way, animals are given short hauls to market in wagons, sent in crates by express, shipped in express cars, or driven overland to nearby local markets.

Great variation exists in the importance of the live-stock markets, ranging from the small local one where a few animals are handled, to that of Chicago, the largest in the world. The nine leading markets in the United States are those of Chicago, Kansas City, Omaha, St. Louis, St. Joseph, Sioux City, St. Paul, Indianapolis and Fort Worth, Texas. In 1905, the Chicago stock-yards received 3,410,469 cattle, 380,835 calves, 8,319,730 hogs, 4,736,558 sheep and 127,250 horses. Nearly 303,000 cars hauled live-stock during that year into Chicago.

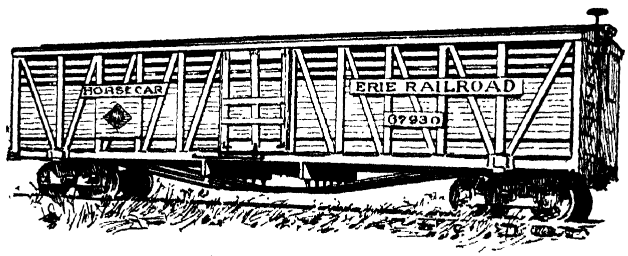

Fig. 136. Modern horse car.

The shipment of live-stock to market involves providing for transportation, for food, water and care en route, and for disposing of the stock when at the terminus of the journey.

Transportation.—(Figs. 135–139.)

A very large percentage of stock sold is shipped by freight. Horses or cattle may be shipped in plain box-cars, or in special stock-cars (Figs. 135–137). The box-car, with entrance at the sides, is usually thirty-four to thirty-six feet long, and accommodates sixteen to thirty head of matured animals

standing closely together, facing the side of the car. For short shipments, common cars will answer. For extended shipments, either regulation stock-cars are used, with feed-racks and water-troughs, or so-called palace stock-cars are employed (Fig. 138). These contain specially fitted stalls, with feed-racks and other conveniences, and are used for horses more than anything else. There are slat cars and open cars, the former being used for cattle more than for horses. Sheep and swine are shipped in box-cars or slat cars, and when a full capacity shipment is made the car has a second floor placed therein, about three and one-half feet above the first floor. Such a car is known as a "double-decker." An ordinary car with but one floor carries 70 to 90 hogs and 125 sheep, while a double-decker will hold 100 to 150 hogs and 200 to 250 sheep or even more. Horses and cattle are packed in cars so as to stand close together and not get on one another. Sheep and hogs occupy the car with more comfort and are able to lie down.

A shipment by freight requires making a preliminary request for a car of the agent of the railroad In some instances this may be secured readily, in other cases it may have to be brought from some other town on the railway, especially if the shipment is to be made from a small local shipping point. In a large city, cars are usually to be had on a few hours' notice. The interior of the car may be arranged to suit the convenience of the shipper, and temporary stalls or partitions may be erected as desired.

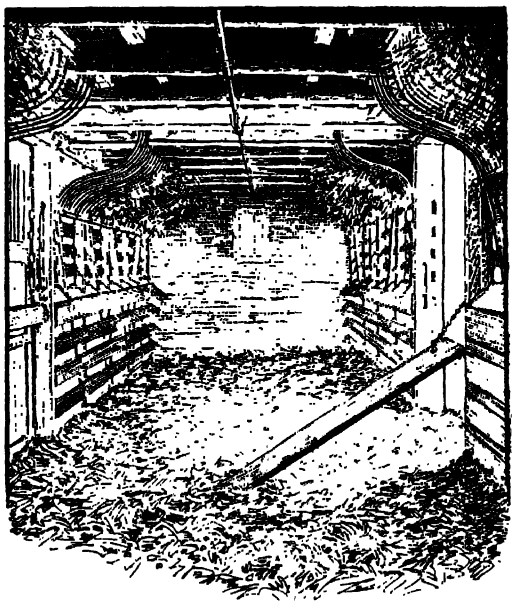

Fig. 137. Interior of horse car.

All shipments by freight or express must be made through the local agent, and a signed bill of lading or contract filled out between the shipper and transportation company. This contract specifies the names of the shipper and consignee, the place to which the shipment is made, the number and description of stock, the weight, and the cost of transportation. If by freight, the car number and initials are specified. Express shipments are usually crated, but all of the express companies own special live-stock-cars, with stall accommodations. These are used almost exclusively for transporting horses, and make up a part of passenger train service. When stock is shipped uncrated in the car, it is customary to allow one

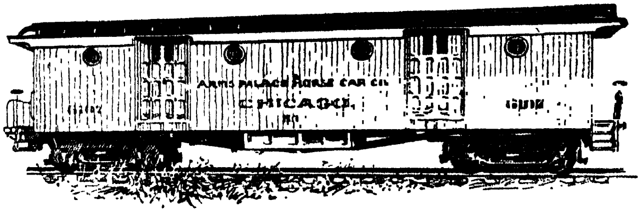

Fig. 138. A palace horse car.

attendant a free passage along with the animals. Even more than this is allowed with a load of horses sent by express. The bill of lading or contract is made out in duplicate or triplicate, one copy of which is given the shipper. He may use this as a passport along with the stock, and it may also serve as a receipt for the prepayment of freight. In the case of a shipment by rail some distance, to a buyer or commission firm, the shipper may send this bill of lading by mail to the consignee if the stock is sent in care of the railway. Shipments of stock by freight or express may be prepaid or not, as conditions seem to make desirable. Persons selling stock on the open market usually prepay freight, while buyers of breeding stock meet transportation charges.

Care en route.

All stock must be properly fed and watered while en route. On short-distance hauls, as, for example, fifty miles, this will not be necessary. A shipment of a carload of stock from Kansas to Chicago would require feed and water. Good, sweet hay is given horses, cattle and sheep, while pigs are usually fed ear-corn. Ordinary stock-cars contain troughs which hold water, and at a certain point along the way water is supplied in a moderate quantity. In case of small shipments of several animals in a car, a barrel for water may be taken along which will supply the needs of the stock. Water and grain should be given only in limited amounts. A carload of steers in a 400-mile run should be provided with about 250 pounds of hay and a bushel and a half of corn each. Stock that is shipped by crate may be fed grain in a small trough built in the end of the crate, while hay may be placed directly in front, within the crate, on the floor. Hay and grain for long trips may be tied in sacks on the top of the crate, and express agents will feed it as required. Some shippers attach feeding directions for agents to the top of the crate. Feeding instructions may be made a part of the shipping card, being placed beneath the shipper's address.

The stock-yards.

The stock-yards to which most of the farm animals of the country are shipped vary greatly in capacity, but the principle of arrangement is generally the same. This includes a long platform for loading or unloading chutes connecting with pens (Fig. 140), and alleys or drives between groups of pens (Fig. 141). By means of gates at various points in the alleys, and at their intersection, one may control conditions and drive stock in any direction desired, to an outlet. All pens should be supplied with feed-boxes and water-troughs, and in the larger yards pens are covered to a greater or less extent. The yards of Pittsburg are almost entirely under roof, while the hog- and sheep-pens of the Chicago yards are also under cover. In the large yards, each class of stock, such as cattle or hogs, is kept in groups of pens by itself.

Fig. 139. Fittings of ocean transport for carrying cattle or horses. (Adapted from Bureau of Animal Industry Report, 1900.)

A live-stock exchange is a most important feature of all large stock-yards. This organization has for its membership the commission men of the market, or the buyers and sellers in the yards. The purpose of such an exchange is to promote uniform and fair methods of trade, provide for adjustment of business disputes, to facilitate the receiving and shipping of stock, and to promote inspection and guard against the selling of unsound or unhealthy meats. The yards are usually owned by an entirely different organization from those making up the exchange, usually known as a stock-yards company. The exchange has a board of officers and directors, and these work in co-operation with government inspectors or agricultural officials in promoting the interests of the yards.

The rules of the stock-yards in different sections of the country vary only in degree. The stock-yards company cares for the stock from its arrival in the yards until it is sold. Water is free, but all feed is charged for on a liberal basis. Hay costs $1 to $1.50 per cwt., according to locality, and corn and oats usually about $1 per bushel. While it is assumed that no charge is made for the use of the yards, there is a charge for weighing, which is termed "yardage." The yardage charge may be fifteen to twenty-five cents each for cattle and five to ten cents each for smaller stock, according to the part of the country. Western charges are less than those East.

Selling.

Nearly all of the stock in the yards is sold on commission. The rates of commission are formulated by the live-stock exchange, and all buyers and sellers doing business in the yards as commission men are bound to charge according to exchange rules. Some of the charges may be expressed as follows, as applied to leading stock-yards: For each head of cattle sold, 50 cents per head up to $12 per carload; $6 per load for single-deck cars or $10 for double-deckers. Twenty-five cents per head is charged for calves, and 15 cents each for hogs and sheep, in mixed loads or for less than carload lots.

The selling of stock, as before noted, is mainly delegated to commission men. The shipper may arrange to send his stock directly to a commission firm and leave the disposal of it entirely in their hands. This is a wise method, because the commission men are well posted on the trade conditions and know where to find buyers better than the man who is not a regular dealer on the market. Each day buyers and sellers go about among the pens and buy and sell. All transactions are for cash. When the stock is sold it is usually at once driven to the scales and weighed. A weighmaster, employed by the yards, weighs the stock and makes out tickets in duplicate for buyers and sellers, as well as an entry in a record book, which is the actual weight basis for all settlements. If the sale is made by an agent, he may send the purchaser a bill which will contain the scale weights, the price per pound and the total sum. The buyer may endorse this and return with it a check, or may write a bank order on the back of the bill, covering the amount. In settling with the person who consigns the stock, the agent furnishes a full statement, and may include a copy of the weighmaster's record. This statement includes the total proceeds of the sale less the freight, yardage, commission, and the like. Commission men as a rule are honorable, and it is in their interests to make good returns to persons consigning stock to them, thus

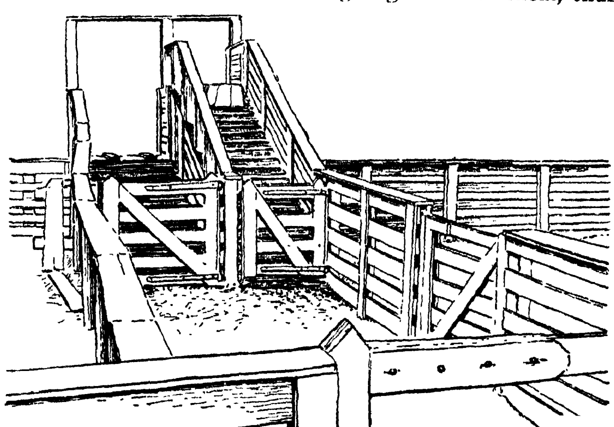

Fig. 140. A loading or unloading chute at stock-yards.

promoting future business. Any other policy would be destructive to a firm's business.

Market grades.

All live-stock sold is divided into different classes and grades. This classification is most complete in Chicago, but it must occur to a certain extent even in the smaller country locality. Market quotations are now sent all over the country from prominent market centers, and prices everywhere are regulated by these quotations. Different classes occur with horses, cattle, sheep and swine, and within the class is a range of grade. With cattle for example,—in Chicago there are classes of (1) beef cattle, (2) butcher stock, (3) cutters and canners, (4) stockers and feeders and (5) veal calves. There are also some other special classes, as Texas and western range cattle, distillers, baby beef, export, shipping, and dressed beef steers and stags. Each class is graded according to its quality and a price with some variation placed on each grade. These grades rank as prime, choice, good, medium, common and inferior. A prime beef steer may bring seven cents a pound, and an inferior one three and a half cents. The intelligent buyer, whether a butcher or shipper, must pay for his stock on some such basis of market quotations.

Sheep and hogs are classified and graded, though not to so great a degree as cattle, while horses are classified according to purpose and graded largely on size, quality, and soundness. As a general proposition, the better classes and grades return the best results to the producers. High-class stock serves as a valuable advertising medium and promotes a demand from buyers. There are feeders of meat stock in the country, who will handle nothing but a choice grade, and who always have a demand for their stock at outside figures some time before it is finished off and ready for shipment.

Inspection.

The inspection of live-stock, through national, state or municipal officials, is practiced generally today in the United States in the larger yards and in inter-state commerce. The Bureau of Animal Industry of the United States Department of Agriculture, under the direction of the Secretary of Agriculture and the Chief of the Bureau, supervises inspection work all over the country. A large number of trained veterinarians inspect stock on the hoof and in the slaughter house, as a protection to home consumers of meats, and as a guarantee of the health of the meats exported. In 1905, there were nearly 66,000,000 head of live animals inspected by the government, with over 40,000,000 inspected after slaughter. According to Secretary of Agriculture Wilson, "there were tagged with the label of inspection in the year 1905, nearly 22,000,000 carcasses of beef, nearly 8,000,000 carcasses of mutton, 845,000 carcasses of veal, 1,000,000 carcasses and 800,000 sacks of pork. Meat inspection stamps indicating the regular post-mortem inspection were affixed to 7,000,000 packages of beef in 1905, and to more than 15,000,000 packages of pork."

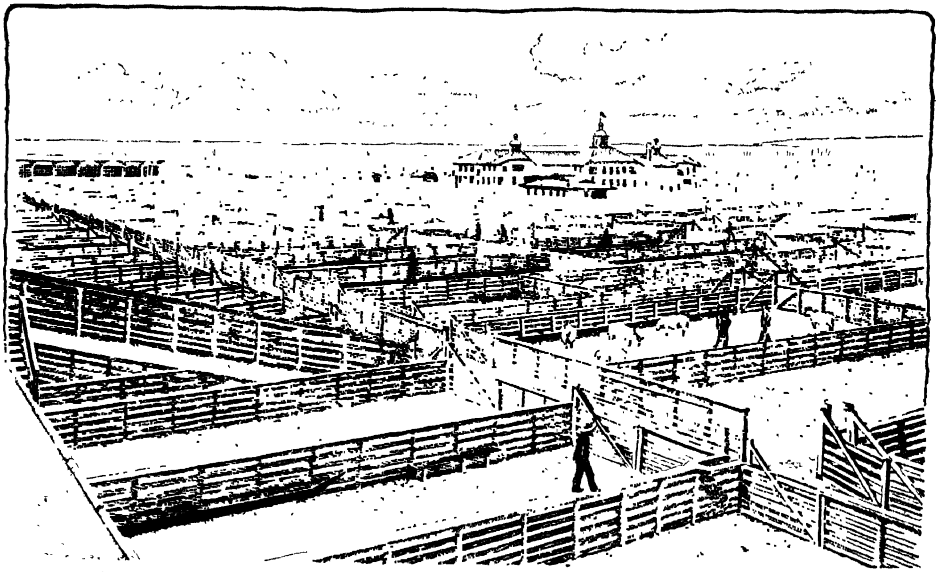

Fig. 141. Stock-yards, Fort Worth, Texas, showing arrangement of pens and alleys.

The export or import trade requires inspection of all vessels and animals passing between the United States and a foreign country. All pure-bred meat stock brought to our shores must be placed in government quarantine; cattle, three months, and sheep and swine two weeks. Horses are exempt from quarantine if passing a veterinary inspection on landing. All vessels in the live-stock-carrying trade must convey stock under national and international regulations, including construction of stabling, attendance, care and sanitation.

All pure-bred breeding stock may be brought to the United States duty free, but it is required that importers fill out certain forms supplied by the government regarding the proposed importation. It is also necessary to furnish detailed information to the United States Consul at the point of embarkation, and to submit certificates of purity of breeding of the animals to be imported; these certificates

being secured from the secretary of the registry association engaged in promoting the breed to be imported. Certificates of health are also required, bearing on the animals in question and the district from which they have been secured.

Quarantine.

In inter-state commerce, quarantine regulations and health certificates are also important. If a contagious disease occurs in one section, other states may quarantine against the state or states affected. Tuberculosis is now regarded as a contagious disease, and cattle for stock purposes cannot be shipped into Massachusetts, Pennsylvania, Wisconsin and some other states, unless they are accompanied by a veterinary certificate indicating that they are free from tuberculosis, based on the tuberculin test. The freedom of trade between states in breeding stock is thus more or less restricted, and the wisdom of the policy is not open to serious question. The all-important subject of the health of our live-stock is receiving a constantly increasing attention from the seller, the buyer, and the consuming public. It is no longer possible to ship horses with glanders, cattle with tuberculosis, sheep with scabies, or hogs with cholera, from one section of the country to another, without serious effort being made to discover and prevent the distribution of the contagion.

When to market.

The time for the marketing of live-stock depends on a variety of conditions; the class, age, condition and demand are all important factors. It may be given as a safe proposition to sell when a reasonable margin of profit is guaranteed. In the case of meat animals, the wisest feeder in the long run is the man who sells when his stock is finished and is ready for the block. It is not a safe policy to continue feeding in anticipation of a rise in values, when the stock to be sold is already over-fed or is too heavy in weight. Neither is it a commendable method to hold on to feeders ready for the block simply because they were bought at too high a figure. The present day market demands a compact, early finished, not over-fat class of butcher's beast. A 1,200- to 1,400-pound steer is preferred to one of 1,700 pounds, and commands a better price. In 1905, the average weight of the cattle received in Chicago market was 1,019 pounds, of hogs 222 pounds and of sheep 83 pounds. There is more waste in the larger, old-fashioned sort; and the producer must meet the more modern demand if he desires to secure the benefit of the best values.

A correct interpretation of values can be secured only by careful study of the stock in the markets, and from acquaintance with the classes and grades, and market quotations. The lessons of the horse markets and the stock-yards are invaluable to one engaged in producing or feeding for the trade. The first lessons may be costly, but with careful observation and experience one becomes familiar with the methods which must be grasped and understood, if he is to buy or sell intelligently. This is not intended to apply alone to the larger producing type of stockmen, but also to the man who feeds a limited number of animals. The difference in the value of two horses or of a carload of cattle or hogs is often far greater than the average man realizes. A carload of twenty cattle weighing 20,000 pounds at five cents a pound amounts to $1,000. A similar load at four cents a pound brings but $800. The difference here may be due to quality and conformation, or it may be due to other factors. If the seller knows his stock and the markets, he will understand clearly the reason for this variation of $200 in the two loads.

A knowledge of market quotations is equally important with the dealer in live-stock. Values fluctuate from day to day and it is always desirable to buy when prices range downward, and sell when figures are tending strong. The daily papers of importance give quotations on the important markets East and West, the agricultural journals furnish the essentials from week to week, while in a few markets, daily drovers' journals give a large amount of the details of the sales, showing classes, grades, weights and sales. In some yards commission houses send customers once a week a printed market sheet, made by the firm, showing range in values of certain classes and grades, with comments on the trade of the week. Such sheets are free, and are widely distributed in shipping territory. Occasional visits to the markets and familiarity with quotations should promote intelligent buying and selling.

Persons shipping stock to the great markets, should study the situation and ascertain what days furnish the best market for trade. For some time the dealers in the Chicago yards have tried to persuade shippers to send in their stock for four market days a week, rather than six. Saturday is a bad day for stock to come in as the business of the week is being cleared up and trade is slack. Stock landed in the yards Saturday may be held over until Monday, at a possible loss from care and shrinkage. If one will study the receipts for each day of the week in the large yards, he will find that it is far better to ship so as to reach the yards on a day not marked for large receipts and, perhaps, showing a glut. If shipment is made through a commission firm, then this will advise as to the best time for shipment and delivery. It is a wise policy, also, to ship only finished stock, and not to rush to the markets half-fed stock when there seems to be a mania for shipping to the yards. A fall in prices always comes at such a time, later to be followed by a stiffening of quotations. One cannot be too well advised as to receipts and quotations, if shipments to the larger live-stock markets are contemplated.

Literature.

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CHAPTER VII

WILD LIFE AND ITS RELATION TO FARMING


The Opossum

THE FARM IS OUT OF DOORS. It has relations with everything out of doors,—with the wild animals as well as the rest. This general relationship has been little appreciated in a conscious way, and the result is that the farming business has not yet been closely adapted to its environment. The great biological fact—as one learns when he studies plants and animals—is that organisms are adapted to their conditions, else they do not thrive to their utmost, or, if adaption is wholly lacking, they die. The best farming is not that which follows an ideal schematic system as laid down by teachers and books, but that which best fits the particular environment, as a plant or an animal fits its environment.

If all this is true, then it follows that, other things being equal, the best naturalist makes the best farmer,—if, by naturalist, we mean one who has knowledge of the nature about him and is in sympathy with it. Therefore, every agency or influence that brings the farmer into closer touch with the nature of which he is a part is a distinct gain in establishing his point of view and directing his energies. The wild mammals and birds contribute directly to hinder or help his farming: but the larger significance of his study of them is that it brings him one point nearer to the perfect understanding and accord that in the end will make the perfect farmer.

WILD MAMMALS IN THEIR RELATIONS WITH AGRICULTURE

By *Clarence M Weed*

The mammals form a very distinctive group of warm-blooded animals, the wild members of which are of much importance to American agriculture. No satisfactory common name other than the word "mammals" has been found for them, although many persons seem to think that the word "animals" is a synonym. They are also often spoken of as quadrupeds.

Pouched mammals.

The marsupials or pouched mammals, the lowest order, exhibit only one species north of Mexico,—the opossum of the middle and southern states. Technically this is *Didelphis Virginiana*, with a named variety in Florida and another in Texas. This famous omnivorous creature is of slight importance agriculturally, although it feeds to a considerable extent on insects and the smaller mammals; much of its food is dead, however, before the opossum finds it. Among the negroes the opossum is a favorite article of diet.

Hoofed mammals.

Above the marsupials comes the great order of hoofed mammals (Ungulata), in which the agriculturist finds many species of interest. The collared peccary of the far Southwest can hardly be said to be one of these, but the various species of deer hold the farmer's attention for several reasons: they furnish food and sport, and they often damage crops to a considerable extent. One of the leading agricultural issues in New England legislatures during recent years has been the demand of the farmers for the right to protect their crops from the ravages of deer, the laws as commonly administered having denied them this right. In some states, changes in the laws have been made, which enable the farmer to kill deer while they are engaged in doing such damage, the shooting to be done with shot-gun rather than rifle, and the facts to be reported at once to the nearest authorities. This seemed a just solution of a vexatious problem, and probably points the way for future legislation in other states.

Rodents.

The great order of rodents or gnawing mammals (Rodentia) includes a large number of species of great importance to agriculture, chiefly because they are destructive to many crops and to stored products. These animals are largely vegetable-feeders and are especially characterized by the peculiar structure of the incisor teeth, which are coated with enamel only on the front surface, and continue to grow during life. Consequently, the owners must be continually gnawing on substances more or less hard to keep these teeth in their normal condition. There are no canine teeth, and the

jaws are capable of moving sidewise as well as vertically. Many groups of rodents are able to multiply very rapidly and thus to become seriously destructive in a short period.

The true squirrels are the typical forms of the large family Sciuridæ, which includes also the chipmunks, the spermophiles or ground-squirrels, the prairie dog, the woodchuck and the flying-squirrels. The true squirrels, the chipmunks, and the flying-squirrels are of comparatively little importance agriculturally. The red squirrel and the gray squirrel occasionally take a little corn and are destructive to the eggs and young of many birds. In some city parks they are thought to have driven out the birds almost entirely.

Spermophiles or ground-squirrels.—One of the most destructive groups of rodents is that of the ground-squirrels or spermophiles, of the genus Citellus—slender creatures suggestive in form and habits of the familiar chipmunks of the eastern states. In many localities they are known as gophers, although this name is better restricted to the true pocket gophers of another family of rodents. (Geomyidæ.) The spermophiles are strictly ground-loving animals that feed chiefly on seeds and grain, for carrying which they have large cheek-pouches. There are at least fifty distinct forms recognized by zoölogists as inhabiting North America, all occurring in the western states, and most of them being found west of the Rocky mountains.

The life-habits of the ground-squirrel are suggestive of those of prairie dogs. They live in bur-

Fig. 142. Grains injured by ground squirrels. (After Frandsen.)

rows under ground and, generally, in colonies of many burrows near together. The burrows of the Oregon ground-squirrel (*Citellus Oregonus*), as studied by Peter Frandsen, of the Nevada Agricultural Experiment Station, are of a diameter of about three inches, with "one to five openings to the exterior, depending on the length of time the burrow has been occupied. The openings are usually on higher ground and the older ones are surrounded by a mound of well-packed earth a few inches in height, which probably serves to keep water out of the hole. From the opening the burrow descends to an average depth of eighteen inches and then runs nearly parallel with the surface, often with many turns, for a distance of ten to fifty feet. Frequently the burrow branches, and some of the branches may end blindly. There are occasional widenings or chambers, which are probably for the purpose of enabling the animals to turn around. There is usually a nest which forms an enlarged side chamber to the main burrow and is sometimes raised a little from it. It is lined with the bark of sage-brush, greasewood, rabbit-brush, blades of grass, or with any other material that may be convenient." Early in spring the young are born, generally in April, each litter numbering about six.

The injury to crops is especially marked in spring and early summer, the more tender and juicy parts of alfalfa and other forage crops being especially sought, although to get these parts the whole stalk is commonly cut off near the surface of the ground. In the case of oats and other grains, this cutting down is often done about the time of heading-out, large fields being sometimes destroyed by the pests. Before the end of summer the Oregon ground-squirrels go into hibernation in their burrows, the sleeping period lasting six or eight months. A thick layer of fat is developed beneath the skin before the beginning of the winter sleep.

In addition to the cultivated crops actually destroyed by ground-squirrels, their presence is injurious because of the obstacles that their burrows offer to tillage and irrigation, and through the injury they cause directly and indirectly to native range plants.

Under natural conditions, the spermophiles are preyed on by a variety of birds and mammals; of the former, the eagles, hawks and owls are the most important; of the latter, the badgers, skunks and coyotes are the most destructive. The settlement of the country by white men has led to the reduction of many of these natural enemies, as well as to an increase in the available food supply of the ground-squirrels, two factors which have been chiefly responsible for their rapid multiplication. The methods of restricting this undue multiplication may be grouped under the two headings of encouraging natural enemies and direct destruction by shooting, trapping, drowning, fumigation or poisoning. The stopping of the wanton destruction of all raptorial birds would help greatly in reducing the numbers of the spermophiles and other rodents, and it is generally conceded by those who have studied the subject that the present feeling that such birds are more harmful than beneficial is wrong. The destruction of coyotes and badgers, however, may be justifiable, although the latter have economic value. (See page 168.) Many of the squirrels are also killed by cats and dogs.

A great many methods of using poison on ground-squirrels and related pests have been tried, the safest and most satisfactory material for this use being strychnine. A formula found successful by D. E. Lantz and recommended in Bulletin

No. 129, of the Kansas Agricultural Experiment Station, is as follows: "Dissolve one and one-half ounces of strychnia sulfate in a quart of hot water. Add a quart of syrup,—molasses, sorghum or thick sugar and water,—and a teaspoonful of oil of anise. Thoroughly heat and mix the liquid. While hot pour it over a bushel of clean wheat and mix completely. Then stir in two or more pounds of fine corn meal. The quantity of corn meal will depend on the quantity of extra moisture present. There should be enough to wet every grain of the wheat and no more. Let the poisoned grain stand over night and distribute it in the early morning of a bright day." A tablespoonful is placed near the mouth of the burrow, scattered in two or three little piles. The best time to use this or other poisons is in early spring, when the ground-squirrels are hungry from their winter fast, and when the destruction of the old ones before the young are born will greatly lessen the numbers of the pests.

Prairie dog.—The famous prairie dog (*Cynomys Ludovicianus*), of the western states, is closely related to the spermophiles. Its burrows are much deeper, however, often reaching a depth of more than twelve feet, with a hollow cavity at or near the end in which the nest of grass is placed. The young are born in early spring, generally four in a litter, and develop rapidly, becoming large enough by midsummer to dig burrows for themselves. The food consists chiefly of grasses, grains, and their seeds, as well as the bulbs of wild onions and various other plants. In winter, several live together in the same burrow in a state of partial hibernation, from which they are frequently aroused in milder weather. The injuries due to prairie dogs are chiefly apparent in pasture lands.

The prairie dogs are preyed on by much the same birds and mammals as prey on the spermophiles. They are also open to destruction by man by the same means as are the latter. Poisoning by grains soaked in strychnine solution has proved the most successful way. In Kansas, where the pests formerly caused an annual loss estimated at $200,000, through the use of poison under the direction of the State Agricultural Experiment Station, aided by small legislative appropriations, the prairie dogs were reduced to comparative unimportance in a very few years.

Woodchuck. — Throughout New England and many of the eastern states, the woodchuck or ground-hog (*Arctomys monax*) is the most vexatious of the destructive rodents. It is found as far south as Georgia and as far west as Nebraska, but is most abundant in eastern and northern regions. Its burrows are large, and generally have two or more openings; they are especially likely to be made in the shelter of rocks or boulders, or beneath a fence or brush-pile. The woodchucks hibernate in their burrows, giving birth to the young in spring, and feeding through the spring and summer months on a great variety of crops. Crops of young beans and peas are especially attractive to them, but almost any succulent plant does not come amiss. Fortunately these mammals are easily trapped at the mouths of their burrows, and are also easily killed by the vapor of bisulfid of carbon, the liquid being poured on a handful of moss or other absorbent material and pushed down the burrow, all openings being at once closed. The vapor is heavier than air and will settle to the bottom, where it will kill any woodchuck present.

The beaver, of the family Castoridæ, can scarcely be said to be of agricultural importance at present.

The rats, mice and voles, of the family Muridæ, compose a great group of species which are very destructive to farm crops of many kinds.

Rats.—At the head of the list stands the pestiferous brown rat (*Mus Norvegicus*), doubtless the most universally destructive of all the rodents. This species has driven out the black rat (*M. rattus*) which preceded it, and is now the rat with which every one is familiar. It causes the destruction of millions of dollars worth of property every year in the United States, feeding ravenously on such a variety of products that few things are safe from attack when food is scarce. It is also known to be a common cause for the spreading of disease germs.

Rats are preyed on by the larger raptorial birds, as well as by skunks, weasels, and other predaceous mammals. But the enemies are so scarce and the rats so sheltered that the effect of such natural enemies is generally of little importance. The fecundity of the rats—which enables three or four litters of young to be brought forth each year, each litter consisting of six to a dozen young that mature in six months—is a chief reason for their abundance and the difficulty in checking their injuries. They may be destroyed by poison, however, the best substance to use being barytes or barium carbonate mixed with oatmeal, one part poison to eight of oatmeal, the combined materials being made into a stiff dough by the use of water. This has the advantage of acting so slowly that the victims generally leave the premises in search of water. The pests may also be reduced in numbers by the persistent use of traps, the best general forms being the recently introduced "guillotine traps," which have a strong coiled spring that brings down a crosspiece that kills the rat (Fig. 143).

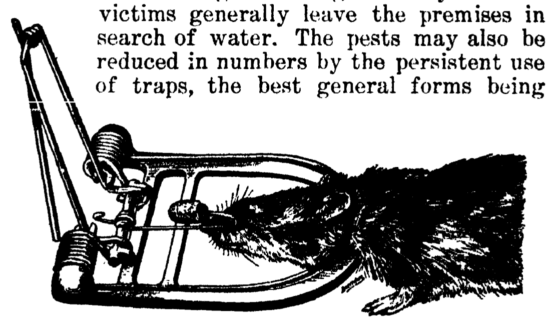


Fig. 143. Guillotine trap for rats. (After Biological Survey.)

Much of the damage that rats cause may be prevented by the use of cement in constructing cellars, basements and foundations generally. A good cat or dog will often clear the premises of rats in a short time.

The house mouse (*M. musculus*) seems in many respects a miniature of the rat. It is commonly found in barns and granaries as well as in houses, and unless checked is very destructive. It is

closely related in structure and habits to the brown rat.

Various native rats are also of interest agriculturally. The cotton rat (*Sigmodon hispidus*) of the southern states is one of the most destructive of these. It is only about half the size of the brown rat, from which it differs considerably in appearance. It attacks corn and other crops, especially when shocked in the field. Many species of wood-rats, of the genus Neotoma, have been described from North America. They are found chiefly in the western regions, where their presence in the woods is made known by the curious piles of brush and rubbish which they gather together over the entrances to their burrows. These piles may reach a height of five feet in case of burrows which have been occupied for a long time. Fortunately, these rats live so generally in the woods away from cultivated fields that they are seldom injurious to crops. They feed on the green bark of trees and other vegetation, as well as the seeds of various plants, often collecting considerable stores of these for the winter supply of food. The injury most commonly complained of is that done to the bark of osage orange hedges.

Mice.—A great number of species of native mice are found in the United States and Canada. The rice-field mice, of the genus Oryzomys, have a comparatively limited range in the South, where they live in swamps and rice-fields. Some fifty forms of the miniature harvest-mice, of the genus Reithrodontomys, have been recognized by zoölogists. These are field creatures living chiefly on seeds and grains, and are comparatively little known even to professional naturalists. A similar statement may be made of the interesting grasshopper-mice, of the genus Onychomys, which are also called scorpion-mice. These two common names indicate a part of the food, these mice being at least partially insectivorous, and feeding on grasshoppers, scorpions and related creatures.

The deer mice or white-footed mice of the genus Peromyscus are among the most attractive of the smaller rodents. They are known by their short front legs and long hind ones, and by the contrast of the white of the lower part of the body with the dark gray of the upper part. They are normally inhabitants of fields and woods, where they live in a great variety of situations and feed on a great variety of food; but they invade buildings, especially when near woods, where they rear their young in nests in any sort of a shelter between the walls. They feed on seeds and fruits of many sorts of wild and cultivated plants, as well as on insects and roots of various sorts. They remain active through much of the winter, in preparation for which they lay up stores of seeds and nuts, and their footprints on the snow may commonly be seen almost any winter's day.

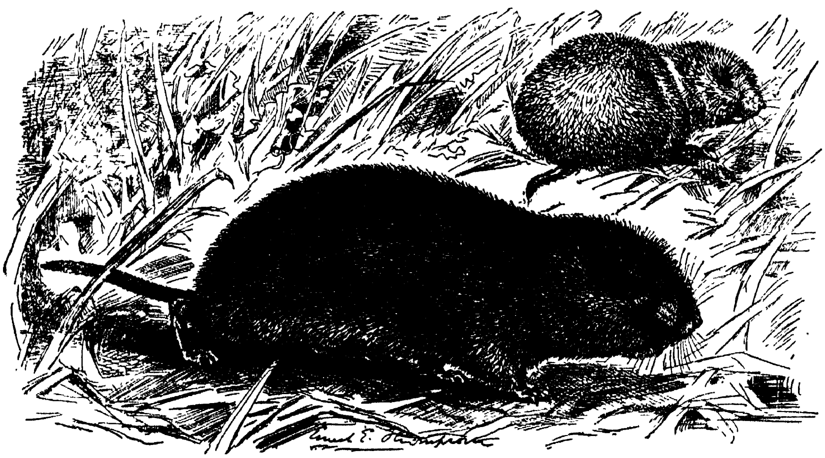


Fig. 144. Common vole or meadow mouse (*Microtus Pennsylvanicus*). (After Biological Survey.)

The voles, or meadow mice, of the genus Microtus (Fig. 144), form one of the most destructive groups of mammals. Though small in size, they are often present in vast numbers, and cause an enormous injury to agricultural interests. They have many common names, among which are bear mice, mole mice, field mice and ground mice. They live just at the surface of the ground, making runways in summer beneath tangled masses of weeds and grass, and in winter penetrating the snow freely in all directions. They feed on almost any sort of vegetation, as well as on such animal flesh as they may be able to find. They are especially fond, however, of the tender bark of trees and shrubs and the succulent green stems of grasses and grains. To this fact is due their greatest injury, which is that done in gnawing the bark from the trunk and branches of fruit trees, an operation that occurs beneath the snow through the winter and is revealed only when it disappears in spring. Some seventy American forms were described in 1900 by Vernon Bailey in his revision of the genus Microtus.

These meadow mice form a chief element in the food of many hawks and owls, and are constantly preyed on by weasels, foxes, skunks, minks and other predaceous mammals. The destruction of these various enemies has undoubtedly been the chief cause for the increase in the number of voles in many regions, and persons generally need greater enlightenment in the common attitude toward raptorial birds and the smaller predaceous mammals. Fruit trees may be protected by wrapping the trunks with wire netting. D. E. Lantz has reported a successful experiment in poisoning the mice with wheat soaked in strychnine solution.

The common muskrat (*Fiber zibethicus*) is the only other member of the rat family that need be mentioned here. It is widely distributed and sometimes locally abundant, but of comparatively little agricultural importance. Though capable of injur-

ing various crops, it is so persistently hunted that it seldom is really destructive.

The pocket gophers, of the family Geomyidæ, form one of the most characteristic, as well as most destructive groups of rodents. (Figs. 145-147.)

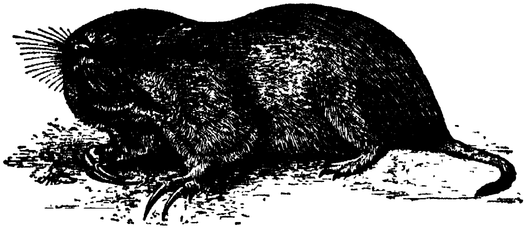


Fig. 145. Pocket gopher (*Thomomys talpoides*). (After Biological Survey)

Some one of the dozen American species occurs in most of the states west of the Mississippi river and as well to a limited extent east of it. The animals are notable for their curious cheek pouches that open externally and are used for carrying food, and for their underground habits, to which their structure is especially adapted. They burrow through the earth in all directions, making, at short intervals, little mounds from the materials thrown out of the burrows. These mounds seriously interfere with the harvesting of crops, compelling the mowing-machine to be set so high that much forage is lost. As they make the tunnels, they feed on succulent roots and tubers of many kinds, often destroying trees completely by thus eating the roots. Some years ago the annual damage in Kansas to a single crop — alfalfa — inflicted by the prairie pocket gopher was estimated at $800,000.

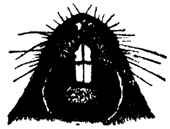


Fig. 146. Face of pocket gopher. (After Biological Survey)

The chief natural enemies of the pocket gopher seem to be the weasels and the bull snakes, both of which follow through the burrows in search of victims. Fortunately, the pests are readily destroyed by poisoned grain, corn being especially recommended for the purpose, although various other materials may be employed. A dibble, made by adding a metal point to a spade handle, is used to make holes in the runways, into which the poisoned bait is dropped. "A skilful operator," writes D.E.Lantz, "can go over twenty to forty acres of badly infested land in a day, and, if the work is done carefully, at a time when the pocket gophers are active, all the animals should be destroyed by the first application of poison." The pests may also be destroyed by trapping and by fumigation with carbon bisulfid.

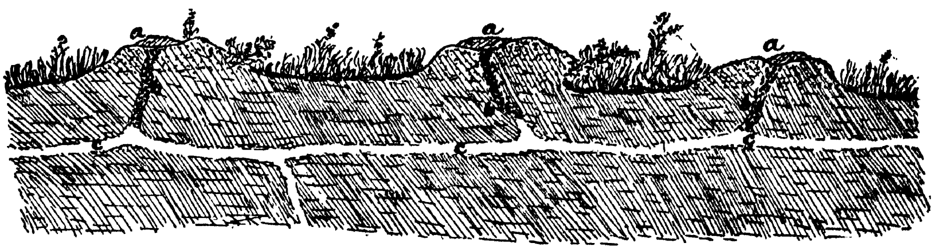


Fig. 147. Runway of pocket gopher. *a*, Mounds of soil; *b*, laterals leading to mounds; *c*, main runway. (After Biological Survey.)

The hares and rabbits, of the family Leporidæ, include a number of species that are often destructive to fruit and other trees, the bark of which they gnaw, as well as to a great variety of field and garden crops which they devour. The larger forms abundant in the western states are called jack rabbits; about seven species are recognized. The largest form in the eastern region is the northern hare, which turns white in winter. The smaller forms are commonly called cottontails, from the color of the turned-up tail, so conspicuous as the animals move about. All these rabbits multiply rapidly, and under conditions favorable to their development they may become serious pests in a very short time. This is especially true of the jack rabbits, which are often destroyed in vast numbers by great "drives" organized by the inhabitants of some of the western states. (Fig. 148.) This is one of the most effective methods of holding them in check.

Porcupines.—Two porcupines (Erethizontidæ) are recognized in North America. These animals are commonly miscalled hedgehogs, although they are very different from the hedgehogs of the Old World. The porcupines are injurious to trees through their habit of feeding on the green bark, and even in extensive forests they often cause considerable loss.

Kangaroo rats and pocket mice.—Several species of kangaroo rats and pocket mice (family Heteromyidæ) are also known; the former sometimes cause considerable damage to corn and other crops in certain regions.

The jumping mice.—The jumping mice (family Zapodidæ) are seldom, if ever, sufficiently abundant to be of agricultural importance.

Carnivorous mammals.

The great order of flesh-eaters, Carnivora, includes many mammals of economic interest to the farmer. Comparatively few of these are harmful under existing conditions, while very many are beneficial because they prey on destructive rodents.

Cat family.—In the cat family (Felidæ) are found the puma or mountain lion, and the lynxes or wild cats. These are comparatively rare and inhabit such wild country that they are of little economic importance.

The dog family (Canidæ) includes the wolves, coyotes and foxes. The wolves and coyotes are very harmful to stock and poultry in the western states, although they do some good in the destruction of hares, prairie dogs and other rodents. They

are most easily destroyed by hunting out the breeding-places in early spring and killing the litters of pups (Fig. 149). They may also be poisoned and trapped. The foxes are generally considered as enemies of the poultry yard, but it is probable that, in general, they do more good in destroying meadow mice and other pests than they do harm in taking poultry.

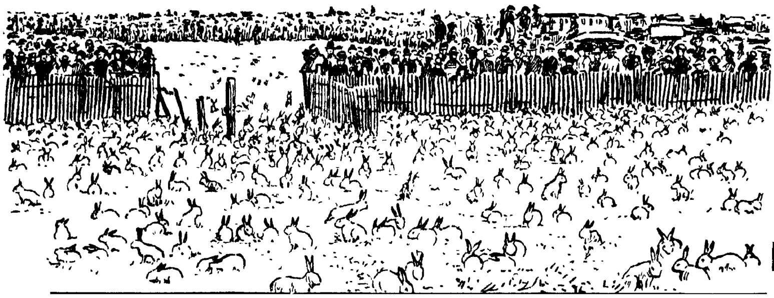


Fig. 148. A jack-rabbit drive.

The bears (Ursidæ) are even yet troublesome in many of the sparsely inhabited regions of the country. In northern New England sheep cannot be kept in certain pastures without danger of attack from the black bear.

The raccoon, which has been called the "little brother to the bear," is familiar to many persons over a wide territory. It feeds on a great variety of animal and vegetable food and is sometimes destructive to green corn in the field.

Badgers, weasels, otters, minks and skunks.—To the family Mustelidæ belong the badgers, weasels, otters, minks and skunks. Many of these animals furnish very valuable fur for which they are eagerly hunted. Many of them, also, are of great value to agriculture because they feed so largely on injurious insects and destructive rodents. The badger of the West is a notable example of this, feeding chiefly on ground-squirrels and prairie dogs, which it can easily get because of its wonderful ability to burrow rapidly through the ground. Even the skunks, which are universally condemned as enemies of poultry, doubtless do vastly more good than harm, hunting persistently for white grubs, voles and other pests.

The black-footed ferret of the great plains region (Fig. 150) is one of the most effective exterminators of the inhabitants of prairie-dog towns, and in infested regions should not be killed on sight.

Insectivorous mammals.

The shrews and moles are the important representatives of the order of insect-eaters—Insectivora. The former are very seldom seen, being nocturnal in their habits. They feed on insects and probably on such small rodents as they can catch. The garden mole is the most familiar member of the order; its runways at least are known to most persons in the country. It is commonly said to be beneficial from its habit of feeding on white grubs and other insects, but this fact will hardly compensate for the damage it does. Moles are rather easily poisoned by inserting in the runways corn in the milk stage, freshly cut from the ear, and poisoned with strychnine solution. They may also be caught in mole traps, and in various other ways.

Bats.—The curious winged bats make up the order Cheiroptera. They fly only at night and feed exclusively on insects flying at the same time. For this reason they may fairly be said to be among the most beneficial of the mammals, and their wanton destruction should never be permitted.

The control of destructive wild mammals.

It has been a common practice in many states, to attempt to reduce the damage done by destructive mammals by the offering of bounties. Vast sums of money have been expended in this way with very little practical result. As long as the animals are so abundant that it is profitable to hunt them for the bounty, they are killed, but, as soon as they become scarce, the killing stops, and the animals begin to increase again. The best informed authorities agree that the bounty system is pernicious in the case of most mammals. The saner way is to attempt to help nature hold the balance of life true by encouraging the natural enemies of injurious pests and by the coöperative use of poisons, traps and other methods of destruction, which experience has shown to be of value.

Fig. 149. Wolf den. (After Biological Survey.)

Literature.

Our knowledge of the economic relations of American mammals is very largely due to the invaluable work of the Biological Survey of the United

States Department of Agriculture. For many years this corps of investigators has been patiently studying the problems involved, and has published a long series of scientific and practical reports in which will be found a discussion of nearly every phase of the relation of these animals to agriculture. The following are some of the more important of these. A complete list may be had on application to the Survey: Vernon Bailey, Revision of American Voles, North American Fauna, No. 17; Same,

Fig. 150. Head of black-footed ferret (*Putorius nigripes*). (After Biological Survey)

The Pocket Gophers of the United States, Bulletin No. 5; Same, Destruction of Wolves and Coyotes, Circular No. 55; Same, Wolves in Relation to Stock, Forest Service Bulletin No. 72; David E. Lantz, Coyotes in their Economic Relations, Bulletin No. 20, and Farmers' Bulletin No. 226; Same, Methods of Destroying Rats, Farmers' Bulletin No. 297; Same, Destroying Pocket Gophers, Circular No. 52; Same, An Economic Study of Field Mice, Bulletin No. 31; C. Hart Merriam, Revision of the Pocket Gophers, North American Fauna, No. 8; Same, Synopsis of the Weasels, North American Fauna, No. 11; Same, Prairie Dogs, Yearbook, 1901, and Circular No. 32; T. S. Palmer, The Jack Rabbits of the United States, Bulletin No. 80. Valuable articles have been published by some of the agricultural experiment stations, notably in Bulletin No. 129, of the Kansas Station, in which David E. Lantz discusses Kansas mammals in relation to agriculture, and in Bulletin No. 58 of the Nevada Station, in which Peter Frandsen discusses ground-squirrels and other rodent pests.

BIRDS IN THEIR RELATIONS WITH AGRICULTURE

By *Edward Howe Forbush*

The relations of certain birds to agriculture are so complicated that they are not yet fully comprehended even by the economic ornithologist, and they are often entirely misunderstood by the farmer. When a few species of birds destroy the farmer's grain, fruit or poultry, the injury is conspicuously evident; but many species feed on the enemies of grain, fruit and poultry, as well as on those of trees and crops of all kinds, and these beneficial habits of the many usually escape notice, while the harmful habits of the few become widely known.

The food relations existing between birds, insects, other animals and plants are so obscure, and the results of the feeding habits of birds are so far-reaching, that often it is difficult for the investigator to determine whether a given bird is a friend or an enemy to the farmer. When the food of all forms of animal life shall have been studied carefully, the scientist will be in a better position to determine the exact value to man of certain species of birds. Nevertheless, enough has been done in this little-known field to warrant the general statement that birds greatly benefit the farmer.

Species vary greatly in value, however. A few are inimical at times to the interests of the husbandman; others seem to be of little or no economic importance; the position of others is doubtful, as their beneficial and harmful habits appear to balance each other; but the vast majority of those land-birds that live in or migrate through agricultural regions are thought to be far more useful than injurious.

Birds are such active, energetic creatures,—their respiration is so rapid and their temperature so high,—that they need an amount of food in proportion to their size far in excess of that required by mammals. An adult bird has been known to consume more than its own weight of food in a single day, and the growing young of most small land-birds often take a still larger quantity. Endowed with wings of the highest type, and telescopic powers of vision, birds can concentrate quickly wherever food is abundant. They are capable, therefore, of being very injurious or very serviceable to the farmer, according to the nature of the food they take from his gardens, fields, orchards or vineyards. When, for example, crows flock in the meadows, they may be very useful in destroying grubs, cutworms and grasshoppers; but crows in the corn-field are not always an advantage to the farmer.

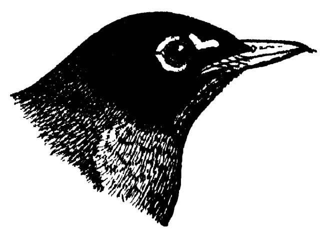


Fig. 151. American robin.

Birds form a standing aërial army for the suppression of uprisings in nature. The scouts are always spying out the land and the swift detachments and flying legions gather at threatened points and attack the swarming hosts of destructive insects or other animals, or the too numerous seeds or fruits of herbs or trees, and so assist in maintaining the biological balance and ordering the general good. Numerous instances on record show that birds have saved trees and crops from destruction by insects or other pests, and local extirpation of birds, or great reduction in their numbers, has been followed in all recorded cases by an increase of pests and consequent injury to vegetation.

Investigators who have examined the contents of birds' stomachs have found large quantities of injurious insects and weed seeds. In the stomach of a yellow-billed cuckoo were 217 fall webworms; in another, were 250 tent-caterpillars. Two flickers' stomachs contained, respectively, 3,000 and 5,000 ants. A nighthawk had eaten 500 mosquitos; another, 60 grasshoppers, and another revealed the remains of 1,000 flying ants. Twenty-eight cutworms were taken from the stomach of a red-winged blackbird. Seven cedar birds had eaten 70 to 100 cankerworms, each. Three mourning doves had taken seeds (mostly those of weeds) to the number of 7,500, 6,400 and 9,200 respectively. Stomachs of the common snowbird or snowflake have been found to contain 500 to 1,500 weed seeds, each. Nine mice were eaten in succession by a young barn owl, about two-thirds grown, and near an owl's nest were found 453 skulls, mostly those of mice. These statements will suffice to show the capacity of birds' stomachs; and digestion is so rapid that the stomach must be filled many times each day.

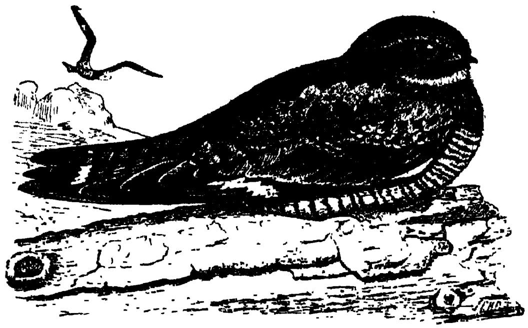


Fig. 152. Nighthawk.

Insect-eating birds.

The insect-eating birds are of the greatest value in regulating the numbers of those insects which feed on trees and those which subsist on grasses. Therefore, the farmer is largely indebted to birds for his annual product of wood and timber and for the grass and hay which furnish subsistence for cattle, horses and sheep. In wood and field, nature is allowed to take her course for a certain period until the crop is **ready to cut, and little can be done by the farmer to protect either woodland trees or field grasses from their insect enemies.**

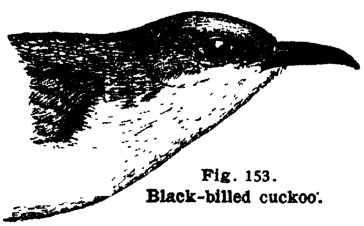


Fig. 153. Black-billed cuckoo.

But birds find congenial homes in field and woodland, and nesting there comparatively undisturbed by man, they find their food in the abundant enemies of grass and tree and do their part in saving both from insect injury. Certain birds are fitted to search out the insect enemies of each part of the tree. Woodpeckers attack borers and bark insects; creepers, nuthatches and titmice search out those insects peculiar to trunk and limbs; warblers and all the smaller birds assail insects injurious to foliage. Crows, robins, sparrows, woodcocks, sandpipers, meadowlarks and other ground-feeding species unearth insects in the fields; while all birds of the open take insects from the grass. Grasshoppers and caterpillars, the most conspicuous enemies of grasses and trees, respectively, form a staple food for nearly all land birds.

Birds may be quite as serviceable to man in orchard and shade trees as in field or woodland, if they receive protection and are provided with safe nesting-places and sufficient shelter at all seasons; but they are not ordinarily so useful in gardens and cultivated fields, for there they find no safe nesting-places, and the frequent operations of tillage during the time when insects are most destructive tend rather to drive them out. A few species, however (notably the robin, house wren, chipping sparrow, song sparrow and quail), are very destructive to garden insects; while swallows, nighthawks and martins, which catch insects in the air, are serviceable about the garden and cultivated field.

The hairy woodpecker, the downy woodpecker and their allies are among the most useful birds of woodland and orchard. These birds peck into the trees and abstract wood-boring ants, the larvæ of wood-boring beetles and the hibernating larvæ or pupæ of injurious moths. The downy woodpecker is particularly destructive to the white pine weevil, the codling-moth, the apple-tree borer, the woolly aphis and other enemies of the orchard. These woodpeckers should not be confounded with the red-bellied sapsucker, which is sometimes injurious to trees in the more northern parts of the United States.

Fig 154. Apple-tree bark, showing cocoon of codling-moth pierced by woodpecker. (After Petit.)

Warblers are insect-eaters chiefly and feed mainly among the leaves. Small caterpillars, tree hoppers and other destructive leaf-eating insects are much sought by them; also plant-lice, moths and beetles, many of which are taken on the wing. The American redstart is one of the most beautiful and widely distributed species. It is a bird of great activity, with striking orange and black plumage and moves through the woods like an erratic tropical flame. Warblers destroy great quantities of injurious insects and also act as a wholesome check on some beneficial species.

Cuckoos are noted as the greatest enemies of those pernicious hairy caterpillars, the ravaging larvæ of the bombycid moths, but warblers, thrushes, catbirds, blackbirds, woodpeckers, vireos, chickadees, crows, jays and some other birds eat these caterpillars at some stage of growth with more or less avidity. Warblers take mainly the smaller caterpillars; vireos, chickadees and orioles dissect

out the inner parts of the larger ones, and blackbirds, robins, crows and jays swallow the caterpillars whole, in all stages. Fully fifty species of birds are now known to feed on the different stages of the destructive gipsy moth. Fly-catchers, swallows, martins, swifts, and night-hawks catch mainly insects in flight. The kingbird and phœbe are among the most conspicuous useful fly-catchers about the farm. The phœbe often nests about buildings or under bridges. It feeds on a variety of pests, among them the imported elm-leaf beetle, the striped cucumber beetle, cankerworms, cut-worms, brown-tail moths and gipsy moths.

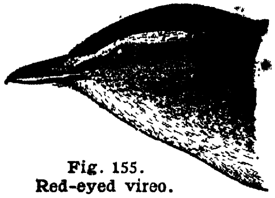


Fig. 155. Red-eyed vireo.

The kingbird is sometimes regarded as an enemy by bee-keepers, but stomach examinations show that the bees eaten are mainly drones, and the birds destroy robber flies and other insect enemies of bees as well as injurious May beetles ("June bugs"), weevils, click beetles, grasshoppers, crickets, house-flies, cattle-flies, leaf hoppers and injurious bugs and moths. As it also drives hawks and crows away from the poultry-yard, it may be considered one of the farmer's best allies.

Swallows are valuable everywhere. The common barn swallow and the cliff (or eaves) swallow, which find nesting-places either in or on buildings, undoubtedly save the farmer many dollars by destroying insects that would otherwise greatly decrease his grass crop. The purple martin takes many house-flies, horse-flies and injurious garden insects.

The thrushes feed much on the ground-frequenting insects in spring and fall, but subsist largely on fruit (particularly wild fruit) during the summer. The American robin is the most useful of all American thrushes, for it has become half-domesticated about the farm and feeds mainly in cultivated grounds, taking ground-beetles, cutworms and white grubs in numbers that possibly no other bird can equal. The blue-bird is second in usefulness to the robin, but is not destructive, like the robin, to cultivated fruit.

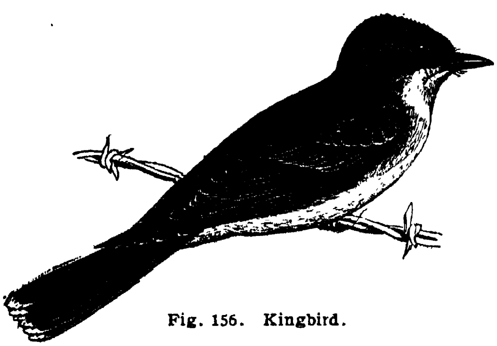


Fig. 156. Kingbird.

Sparrows are regarded as seed-eaters; but, with the exception of the house sparrow, commonly known as the "English sparrow," they all feed mainly on insects during the spring and early summer, and they feed their young in the nest almost entirely on insects. The insects taken are chiefly either injurious or neutral in character and very few useful species are eaten. Sparrows are very fond of the seeds of weeds, and they feed chiefly on seeds in the fall, winter and early spring months. They eat very little cultivated fruit, and not much grain, and as a family, are of great benefit to the farmer. The introduced "English sparrow" is the only species regarded as a pest.

Birds of prey.

The birds of prey are in many cases valuable aids to the farmer. The owls are thought to be among the most beneficial of all birds. They destroy many injurious night-flying insects and numbers of caterpillars that escape the diurnal birds; but their special function is to hold in check the increase of the smaller nocturnal or crepuscular mammals. The hawks are nearly as useful as the owls in this respect. In certain regions of England and Scotland, where the hawks and owls have been nearly driven out, field mice or voles have increased from time to time, destroying crops and pasture. In such cases their progress has been stayed at last by migrating hawks and owls that have assembled from other regions.

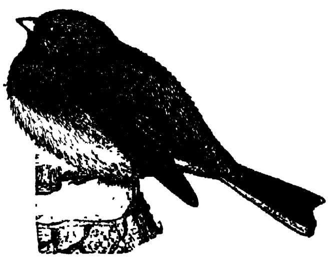


Fig. 157. Slate-colored junco.

Dr. A. K. Fisher, of the United States Department of Agriculture, examined the stomach contents of about 2,700 hawks and owls, and Dr. C. Hart Merriam, Chief of the Division of Ornithology and Mammalogy, says of the results of this investigation: "Only six of the seventy-three species and subspecies of hawks and owls of the United States are injurious. Omitting the six species that feed largely on poultry and game, 2,212 stomachs were examined, of which 56 per cent contained mice and other small mammals, 27 per cent insects and only 3½ per cent poultry and game birds."

Bird depredations.

The injury done by birds is confined to a few species, but they sometimes cause considerable loss to the farmer or fruit-grower. The greatest damage attributed to birds in any section of the United States is that inflicted on the rice crop of the southern Atlantic seaboard by bobolinks and blackbirds, which, under the name of rice birds, cause an annual deficit of nearly $2,000,000 in the planter's crops. Blackbirds often commit depredations in other parts of the country, either by picking up grain from newly sown fields, or by attacking the standing grain. The destructiveness of crows in the corn-field has become proverbial. Sometimes individual fruit-growers suffer considerable loss by

the depredation of crows, robins, catbirds, cherry birds, orioles *and a few other species. All these birds are more or less useful to the farmer, and the problem that the fruit-grower faces is, not how to destroy the birds, but how to protect the crops and spare the birds.*

The protection of crops and poultry from bird depredations.

This problem has never yet been fully solved nor has its solution been more than casually attempted by any thoroughly competent investigator. Still something has been done in this direction by practical farmers.

Crows are prevented from pulling up young corn by either tarring the seed, planting it deeply, scattering soaked corn over the field to attract attention from the young plants, hanging streamers of cloth from twine strung about the field on poles, or using various scare-crows or effigies.

Persons who plant cherry trees may usually secure immunity for the fruit by planting nearby, at the same time, trees which bear a fruit that the birds prefer to cherries. The Russian mulberry offers the best protection for early fruit, and will succeed in most parts of the temperate zone. Plantings of mulberry, buckthorn, elder and chokeberry may serve to protect raspberries and blackberries. H. A. Surface, State Zoölogist of Pennsylvania, says that strawberries and other berries may be protected by planting sweet early fruits which are left to ripen on the vines for the birds. When no other method is available, small beds of strawberries and small cherry trees may be covered with small-meshed fish-net, when the fruit is about to ripen.

Young chickens may be insured against the attacks of hawks by covering with portable runways of fine wire netting, which may be set on grass land and moved often. Chickens are comparatively safe wherever kingbirds or purple martins breed about the farm-yard, as these birds drive hawks away. Some hawks are frightened away by guinea hens. A pair of ospreys or fish-hawks nesting near a farmhouse will keep other large hawks away.

The encouragement of useful birds on the farm.

It is important to the farmer to be able to protect the useful birds about the farm so as to increase their numbers. If, with little trouble and *expense, he can make his farmstead attractive to the more valuable species, he may be able to lure to it and maintain on it, more birds than it would ordinarily support,*—particularly if he is willing to provide them with a little inexpensive food to tide them over hard places. In this way, he may secure on his own land the full benefit of the services of birds as insect- and weed-destroyers.

Food is the magnet which will attract all species. A diversity of vegetation will provide a variety of insect and vegetable food. It is important that groves and thickets should be left about the farm for bird shelters and insect refuges. The growth of existing fruit-bearing trees, shrubs and vines may be encouraged, or others may be planted especially for the birds.

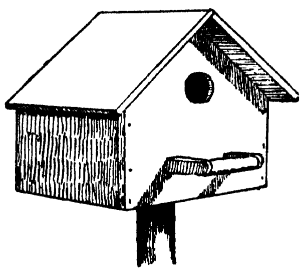


Fig. 158.
For wrens or tree swallows.

Fig. 159.
Slab bird-house.

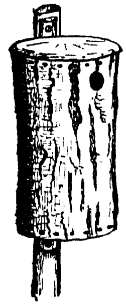


Fig. 160.
Bark bird-house.

Fig. 161.
Birch-bark box.

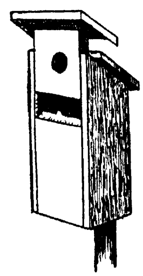


Fig. 162.
Box with sliding front.

Nearly all wild fruits, except a few of the most poisonous, are eaten by birds, and many that are not considered edible are not disdained by them. Fruit which, like the berries of the barberry, juniper, sumac and smilax, remains on the plant in fall and winter, is a godsend to the birds in times of stress. Many of the winter sparrows may be gathered about the farm-yard by scattering on the ground a supply of chaff and hayseed from the barn floors. This feeding should be begun in the fall and continued in some open shed with a southern exposure when the deep snows of winter cover the ground. A scratching-shed for poultry is an ideal place as a shelter and feeding-ground for small seed-eating birds. The birds thus fed will spend most of their time during fall, winter and early spring in searching for and eating the seeds of weeds about the farm and garden. The insect-eating winter birds may be tolled to the orchard by tying on the trees, in sheltered places, bits of suet, and bones with shreds of meat attached.

If these precautions are taken in the fall and continued throughout the winter, many birds will be attracted by them and will remain wherever the eggs and other hibernating forms of insects are plentiful on the trees. Orchards may sometimes be nearly freed from native pests by this method alone; but some of the more recently introduced insects seem to enjoy a greater or less immunity from the attacks of native birds.

There are many attractive bird-foods that may be used in winter; among these are the seeds of

hemp, sunflower and Japanese millet, bread crumbs. doughnuts or crullers and nuts. In the winter, pieces of suet or fat meat (unsalted) may be tied in trees to feed the small woodpeckers, chickadees and nuthatches. But a variety of food is not so necessary as is a supply of coal-ashes or sand, which furnish the mineral matter that the seed-eating birds require to grind their food.

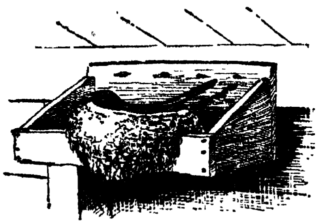


Fig. 163.
Phoebe's nest in shed.

One reason for a scarcity of certain birds is a lack of suitable nesting-places in the hollow trunks or limbs of trees. To attract these birds, some of which are among the most valuable insect-eating species, it is only necessary to put up suitable nest receptacles. These may be made of small wooden boxes or tin cans, with an entrance in each near the upper or outer end. This hole should be one and one-half inches in diameter for blue-birds, one and one-fourth inches for chickadees, about one inch for wrens and two or more inches for other larger birds.

The above dimensions are such as will barely allow the entrance of the species mentioned in each case, and will keep out most of its enemies. Those who would cater to unusual visitors may bear in mind that a flicker or a screech owl will require an entrance about three inches in diameter, while a wood duck will use an opening five inches in width.

The size of the box is not material, provided only that it is large enough, but the entrance should be so high above the bottom of the box that the cat cannot reach in and claw out the young birds. If the box be not so constructed, it should be so placed as to be inaccessible to this arch enemy of the birds. To be most useful, a nesting-box should have the opening turned away from prevailing storms, and should be protected by a tight, overhanging roof. Its bottom should not be tight enough to hold any water that might chance to drive in. The box should be so situated as to be be shaded in the hotter part of the day, and the entrance should be made accessible by means of a hinged or removable door, slide or cover, so that the box may be readily cleaned and undesirable tenants may be speedily evicted. All the above conditions may be met without any expense by the use of worn-out utensils, such as milk cans, coffee-pots, tea-kettles, or fruit cans slightly altered for the purpose.

Suitable and ornamental boxes may be made of the bark of the elm, chestnut and birch, all of which are desirable. The bark may be easily removed in June from a freshly cut sapling, cross sections of the trunk may be used for the bottom and top of each box, and the roof may be covered and protected by tin, zinc, or bark (See Figs. 159, 160, 161). The elaborate "architectural" houses that one often sees are not appreciated by the birds, nor are they always in good taste; but they are serviceable for purple martins.

Openings through which swallows can come and go, should always be left in all barns. If the rafters are so smooth as to offer no points of attachment for the nests, cleats should be nailed up here and there. Eaves swallows will not nest on painted barns unless a ledge or cleat is placed on the outer wall beneath the eaves. Little trays or shelves may be put up in sheds to accommodate the nests of robins and phœbes, and it is well to hang out tow cotton or string for the use of such birds as orioles, vireos and fly-catchers.

Honeysuckle, bee balm, salvia and most trumpet-shaped flowers invite the humming-birds, which are destructive to minute insects and they assist in fertilizing flowers. Gunners, particularly boys, and bird-shooting foreigners, should never be allowed about the home grounds, the garden or orchard. Cats, bird-hawks, snakes, crows and jays, English sparrows or squirrels that have the bird-nesting or bird-killing habit, should be summarily dealt with, and children should be taught to care for the birds and not to molest them.

Literature.

Readers who desire more detailed information are referred to the report on "Useful Birds and Their Protection," by the present writer, issued by the Massachusetts State Board of Agriculture in the year 1907; Weed and Dearborn, Birds in Their Relation to Man, J. B. Lippincott Company (1903).

Fig. 164. Cedar birds eating canker-worms.

Numerous bulletins treat of this subject, notable among which are those of the State Department of Agriculture at Harrisburg, Pennsylvania, and of the Bureau of Biological Survey, United States Department of Agriculture. Among the latter may be mentioned the following bulletins: No. 1, The English Sparrow in North America, W. B. Barrows; No. 3, The Hawks and Owls of the United States in Their Relation to Agriculture, A. K. Fisher; No. 15, The Relation of Sparrows to Agriculture, Sylvester D. Judd; No. 17, Birds of a Maryland Farm, a Local Study of Economic Ornithology, Sylvester D. Judd; Farmers' Bulletin No. 54, Some Common Birds; C. F. Hodge, in Nature Study and Life, Ginn & Co., devotes three interesting chapters to economic bird study and bird protection from the standpoint of a teacher.

PART II

THE MANUFACTURE OF ANIMAL PRODUCTS

Every important animal affords material for one or more manufactured products. These products are of several classes or kinds, as: Direct fresh food products, the parts being unchanged in character, as meat, eggs, milk; preserved natural food products of many kinds; manipulated or manufactured food products, in which the original form is radically changed, as butter, cheese, lard; clothing products, as leather, wool-fabrics, mohair; fertilizer products, as bone flour, tankage; soap products; many incidental or secondary materials used in the arts, as bone, horn, glue, leather, ivory. It would be interesting to make a catalogue of all the manufactured or manipulated products of the animals described in this book. If the list were at all complete, the reader would be astonished to know the extent to which we depend for our well being on the common animals of the fields. We depend on common things for the necessities. Exotics are mostly luxuries or amenities.

The manufacture of many of the animal products lies closer to the farm than the manufacture of crop products. This is particularly true of butter and cheese, the manufacture of which is so very closely associated with agriculture itself that the subject is now a recognized part of the curriculum of all modern colleges of agriculture. On the crop side, there are no recognized manufacturing phases now in the colleges, although some of them—particularly the manufacture of fruit products—must soon find a place in these institutions. There is probably no manufacturing business in any college or university that has now reached a higher development than the making of dairy products; and this manufacture is extending beyond cheese and butter to ice-cream and special lines of milk-beverages. On the farming side, the skimming stations, creameries and cheese factories have become an accepted part of the agricultural development of great regions, and their influence extends far into the social phases of country living. There is no other agricultural manufacture that so profoundly modifies agricultural practice or rural association. In a very important way, these institutions provide local centers that check the outlook to the town or city. There is now a marked tendency, however, toward the consolidation of this manufacturing into the larger centers, leaving the isolated establishments to be only scattered collecting stations, with a less vital social interest. On the other hand, there is also a tendency in many parts for good home-dairying to develop a new effectiveness, with improved machinery and appliances and new ideals of sanitary cleanliness; and in certain regions the milk is coming to be separated at home and only the cream taken to the factory or station, thus decreasing haulage and keeping the skimmed milk on the farm. These various tendencies will have marked effects on the home.

In general, the manufacture of animal products is not agriculture, and therefore no complete account of it is due in a book like this Cyclopedia. In fact, the factory making of cheese and butter is usually delegated to men who are specially trained and who are not farmers. Many of the dairy students in the colleges of agriculture are not farmers but factorymen. Inasmuch, however, as the making of cheese and butter is also a home function, a somewhat particular account of this business may rightly be expected here.

With the increase of competition and the rise of constructive intelligence, the utilization in manufacture of waste and secondary products will become more and more important. In the great abattoirs, the utilizing of the animal carcass has arrived at great perfection, but it is not so in smaller establishments nor on farms. As with crops so with animals, a use must be found for everything, else it will not be profitable to grow the animal. The farm-management plans will be modified by the higher development of manufacture or utilization of animal products.

In the [illegible] days, every well-developed farm establishment depended on itself for its animal products,—its salted and smoked meats, sausages and head-cheese, tallow and lard, soap, the tanning

Plate IV. The dairy in which the first "certified milk" was produced. Stephen Francisco, Montclair, N. J.

of hides and the making of shoes by the traveling or the village shoemaker, and the spinning of wool and weaving of cloth. The day of homespun has passed, and a new economic and social order has come in. Manufacture has gone farther and farther from the place of production of the raw materials. It is probable that we shall see a return movement in some of the manufacture aside from milk products. We may hope, at all events, for a return of the home-preparing of meats, with improvements on the old practices in the way of less salt meat and of greater variety. The light power and refrigeration, which are gradually coming on the farms, will aid this work.

Unfortunately, there appear to have been few studies of these subjects of manufacture and coöperation in this country in their agricultural relations. The literature is scattered and special, partly of the recipe order and partly of the technical commercial manufacturing order. The next ten or twenty years is likely to see much change in this condition.

CHAPTER VIII

DAIRY PRODUCTS

Millet's churner

THE MILK OF THE COW IS ONE OF THE FUNDAMENTAL NECESSITIES of our present civilization. With greater attention being given both to its production and to its manipulation, its use is vastly increasing. The milk-producing industry has elements of stability that many other rural industries lack. It has the constancy and regularity of all business that rests on fundamental and daily demand. It now is comparable with the beef industry. Animals, in recent times, have been more developed in milk-producing power than in flesh-producing power.

The advance in modern dairying, however, is less marked in the increase in production than in the careful attention that is beginning to be given to cleanliness. The mere statement of this fact conveys little idea of its great significance, for cleanliness in milk-producing and marketing is vastly more than mere tidiness in the work. It is concerned with the lessening of bacteria, as well as of dirt, in the milk, and it therefore rests on rational scientific procedure. It is well to bear in mind that, of all foods widely used for human consumption, milk has been produced and handled in the most uncleanly way, considering the fact that it is amenable to contamination and capable of propagating germ life. Cows and stables and surroundings are commonly unclean, the animals are unclean, and often the man himself is unclean. The milk is exposed to contamination in unclean cans and to dust and germs from the air. It is likely to be carelessly handled over and over again in transit and in market, in unclean cars, unclean booths and by unclean men. Finally, the consumer himself has not been in the habit of exercising any special care to protect the milk from contamination. All this is the error of nobody in particular, for we have been in ignorance of the facts. This condition is certainly not the fault of the farmer, for he has been as careful as dealers and consumers; and milk has always been erroneously regarded by purchasers as a cheap product.

The demand for clean milk is the direct result of the study of dairy bacteriology, following studies in Europe within the past twenty-five years, and in this country beginning, perhaps, twenty years ago. A "Report on the Dairy Industry of Denmark" by C. C. Georgeson, published in 1893, by the national Department of Agriculture, called wide attention to the improving dairy practice of that country. In the same year (1893) a committee of physicians of Essex county, New Jersey, entered into an extensive contract with Stephen Francisco, a local dairyman, whereby it agreed to certify to the quality of his milk, that was to be produced under rigorous control and inspection. The term "certified milk" (page 186) originated with Henry L. Coit, a member of this medical commission, and it was copyrighted by Mr. Francisco to protect the term from being degraded by dairymen not in contract with a similar commission; but it was distinctly understood that the term should be allowed to others without question when it shall be employed by medical milk commissions organized to influence similar milk-production. The term is now defined by statute in New York state. The Walker-Gordon Laboratory Company, of New York and other cities, adopted the term "guaranteed milk" for their product, which was produced

under rigid conditions of control. The popular result of all the efforts for better milk is expressed in the term "clean milk," which means, in a general way, a product in which the new ideas of cleanliness and control are put in operation. A paper by R. A. Pearson on "Market Milk: A Plan for Its Improvement," published in 1900 by the United States Department of Agriculture, brought the new ideas and practices prominently and officially before the public. There are now about twenty-five medical milk commissions in the United States. In most cases, these exercise supervision over only one dairy. The National Association of Medical Milk Commissions was organized in 1907. In the same year, first steps were taken to organize an association of certified-milk producers.

While great improvement in sanitary conditions of dairies is being made without actually increasing the money cost of milk production, yet these improvements deserve money recognition and will command it. When sanitary improvements are carried to the point required by milk commissions, it is expected that the producer will receive two to three times the ordinary price for his milk. We shall be forced to readjust our scale of values. Milk has not sold for its full value as a food product. The bacterial content is the best measure of the condition of cleanliness of milk. The New York commission enforces a standard of not more than 30,000 bacteria per cubic centimeter. The Philadelphia commission holds the standard at 10,000, but allows two or three re-examinations when the count is found to be excessive.

It is probable that the bacteriological studies that have expressed themselves in the new ideas of cleanliness are destined to have greater effect on agricultural practice than any other single series of investigations. They have already developed a wholly new point of view and new practices in modes of living in both town and country.

MILK AS A MARKET PRODUCT

By *Raymond A. Pearson*

Milk is the natural food of the young of mammalia. It is secreted in the mammary glands of the female parent during a more or less extended period after parturition. The milk of cows is extensively used in commerce, and the milk of some other animals is thus used to a limited extent. The milk of goats, ewes, and buffaloes is commonly used as food in some southern European countries. Mares' milk is used in Russia, asses' milk in southwestern Europe and in Cuba; the reindeer's milk is used in the sub-arctic regions, and it is reported that in some parts of Spain sows' milk is used as a human food. Except when otherwise stated, this article has special reference to cows' milk.

According to the last census, in 1899, there were 17,139,674 milch cows on farms in the United States, and they produced in that year 7,266,392,674 gallons of milk. It is estimated that about 58 per cent of this was used in making butter, on the basis of ten quarts of milk for one pound of butter; 4 per cent was used for making cheese, on the basis of ten pounds of milk, or a little less than five quarts, for one pound of cheese; 5 per cent was used for rearing calves; 1½ per cent was used for making condensed milk at the rate of four to one; 1½ per cent for making cream; 30 per cent was used as market milk, on the basis of an average daily per capita consumption of .6 of a pint.

The composition of milk.

As milk is a complete food for the young, it has all the food constituents necessary for the nourishment of the young. The table shows the composition:

Constituents	Quantity in average milk	Extent of variation in normal milk
	Per cent	
Fat	4.0	2.5 8.0
Casein	2.6	2.0-3.5
Albumen . .	0.7	0.6 0.9
Sugar	5.0	4.0–6.0
Ash	0.7	0.6–0.8
Water	87.0	84.0–88.0

Fat.—Fat in milk is in the form of minute globules, having a diameter of $\frac{1}{15000}$ to $\frac{1}{2500}$ of an inch. These float about in the milk, forming an emulsion. When highly magnified, these fat globules may be easily seen. In any milk, many different sizes of globules are found, but it is noticeable that the average size of globules in Jersey and Guernsey milk is much larger than the average size of globules in the milk given by other breeds. As the specific gravity of the fat is .93 and the specific gravity of the remainder of the milk is about 1.04, the fat globules always tend to rise. They are more or less entangled by other constituents of the milk, and

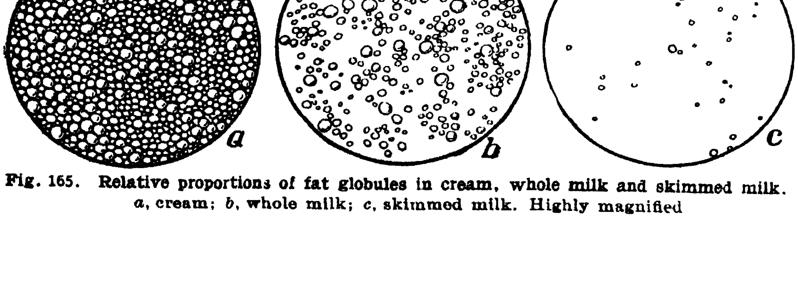


Fig. 165. Relative proportions of fat globules in cream, whole milk and skimmed milk. *a*, cream; *b*, whole milk; *c*, skimmed milk. Highly magnified

great numbers of the smallest sized globules fail to reach the top, or the cream layer. (Fig. 165.)

The most variable constituent in milk is fat, and the following are some of the chief reasons why the quantity of fat differs in different milks:

(1) Breed of cows. The analyses of large numbers of samples of milk given by different breeds have been made by the New York Agricultural Experiment Station, and the averages of fat for the different breeds are:

	Per cent
Holstein-Freisian	3.4
Ayrshire	3.6
Shorthorn	4.4
Devon	4.6
Guernsey	5.3
Jersey	5.6

(2) Individual cows, even of the same breed, differ widely one from another. For example: it frequently happens that Holstein cows give milk that tests 4 per cent fat or better. Thus, some strains or families of cows are sometimes developed within a breed.

(3) The length of period preceding milking. Experiments show that the milk taken after the shorter period between milkings is slightly richer.

(4) Morning or evening milk. Other things being equal, the milk will more frequently be found to be richer in the morning than in the evening.

(5) The portion of the milk tested. The first milk drawn from the udder tests low in fat, while the last contains a large amount of fat. The difference may be as great as 1 to 10 per cent.

(6) The time in lactation period. Generally the richness of milk falls off slightly a few weeks after the calf is born, and then steadily increases to the end of the lactation period.

(7) Age of the cow. Although there are many exceptions, it is customary for the milk to be slightly less rich after the second or third period of lactation.

(8) The health or nervous condition of the cow, caused by the condition of the weather, or otherwise, also seems to affect the amount of fat in the milk. The percentage of fat may fluctuate between wide limits in case of sickness.

Milk-fat is a mixture of several different fats which are combinations of glycerine and fatty acids. The principal fats and their proportion in milk-fat are as follows:

	Per cent
Palmitin	40
Olein	34
Myristin	10
Butyrin	6

A few others vary from 1 to 3 per cent each.

Butyrin is the characteristic butter-fat, and is absent from butter substitutes, such as oleomargarine. The melting point of milk-fat is about 92° Fahr.

Nitrogenous constituents of milk.—Casein constitutes about 80 per cent in this group, albumen about 18 per cent, and other constituents the remaining 2 per cent. (a) In normal milk casein exists as very small gelatinous particles in suspension. It is in combination with calcium in some form. This constituent is coagulated by the enzyme rennet or by mineral acid. Casein is used in the following ways: (1) As food, in milk and beverages made therefrom. (2) In cheese, the manufacture of which depends on the presence of casein. (3) In special proprietary food preparations. (4) In the manufacture of paints and paper-sizing. (5) In making mucilage and cement. (6) As a substitute for horn or celluloid, in which condition it is known as "galalith." (7) As a dressing and color-fixing medium in the textile industry.

(b) *Albumen* is present in milk in small quantity in solution. It resembles the white of egg, and is coagulated by exposure to heat from 157° to 170° Fahr. The specific gravity of the nitrogenous constituents is 1.346.

Sugar.—Sugar is in solution in the water of milk. It is called lactose or milk-sugar. It is the most abundant constituent. Its quantity fluctuates less than that of other constituents above-mentioned. Its specific gravity is 1.666. Milk-sugar is extracted from whey by concentration, by means of evaporation *in vacuo*, and crystallization. It is used largely for coating pills and proprietary foods. It is used also in the manufacture of certain explosives. By its decomposition, which is due directly or indirectly to bacteria, milk-sugar forms lactic acid. Thus—

$$C_{12}H_{22}O_{11} + H_2O = 4C_3H_6O_3 \text{ (lactic acid).}$$

There is very little, if any, lactic acid in perfectly fresh milk, but soon it begins to form, and "sweet milk," on reaching the market or the factory, commonly contains .1 to .2 per cent. When milk contains about .3 per cent lactic acid, the sour taste begins to be noticeable. Under conditions favorable for bacterial growth the acid increases to about .8 per cent, when the bacteria cease to act because of the large amount of acid surrounding them. If some of the acid is neutralized by the addition of an alkali, the bacteria become active, and more acid is formed by the breaking down of more sugar until the limit is again reached. Lactic acid is essential for certain dairy manufacturing processes.

Ash.—This is mineral matter which, in normal milk, is present in the form of a solution, or in suspension. Milk-ash consists of chlorids and phosphates of sodium, potassium, calcium, and magnesium. It contains also traces of iron oxid. Its specific gravity is 4.12. Ash is a most important constituent of milk when used as a human food.

Water.—Milk contains 87 per cent of water. This need not be considered an excessively large quantity; it is not equal to the amount of water in certain fruits and vegetables, and it is less in quantity than the combined water and waste of some of our favored meat foods.

Some physical properties of milk.

Other than those mentioned in connection with the composition of milk, the following physical properties are important:

(1) *The specific gravity* of average milk, or the

relation between its weight and the weight of an equal quantity of water at 39° Fahr. is 1.032. This varies, however, frequently between 1.030 and 1.034, and occasionally the specific gravity of normal milk goes slightly beyond these limits. The specific gravity depends on the quantity and relative amounts of fat and solids not fat, the specific gravity of the fat being .93, and of the solids not fat 1.616. When the fat has been removed in the form of cream, the specific gravity is raised to about 1.036.

(2) *The freezing point* of milk is 31° Fahr., and its boiling point is practically the same as that of water—212° Fahr.

(3) *Milk is most concentrated* at 31° Fahr., its volume slightly increasing with the rise of temperature. Richmond gives the relative volumes of a milk (in glass) having a specific gravity of 1.032 and a fat test of 3.8 per cent at different temperatures as follows:

Temperature Fahrenheit	Volume
31°	1.00000
40°	1.00041
50°	1.00114
60°	1.00229
70°	1.00372
80°	1.00549

Rich milk expands more than poor milk.

Milk tests.

Among the older milk tests, descriptions of which are found in the old text-books on dairying, is the cream gauge. This is a plain glass cylinder, into which a measured quantity of milk is placed and allowed to stand quietly until the cream layer becomes distinct. This test is used to a limited extent today. It is convenient for the household, but it is not accurate, and for commercial purposes has little value. The reason for its inaccuracy lies chiefly in the fact that the cream rises more completely on some milk than on others, and in some cases the cream layer is much more rich or heavy than in other cases, hence the quantity of cream showing on different milks cannot be fairly compared.

Certain optical tests have been more or less used. These tests include the pioscope, and Feser's lactoscope. In these tests the transparency of the milk was supposed to indicate its quality. The pioscope consists of a black rubber disc with a shallow depression, surrounded by a raised ring about the size of a twenty-five cent piece, in the center. The surface of the rubber outside of the circle is divided into several parts, each coming against the central circle, and the different parts showing different shades of white, from a dark gray to very light. These different shades are marked to indicate percentages of fat. A few drops of milk are placed in the center and covered with a small plate of glass. Its shade is compared with those surrounding it, and its percentage of fat is supposed to be the same as the percentage marked on the outside division whose shade most closely corresponds. This test is inaccurate, because the richness of milk does not vary directly with its transparency. For example: a small amount of fat in the form of very small fat globules causes more obscurity than a large amount of fat in the form of large globules.

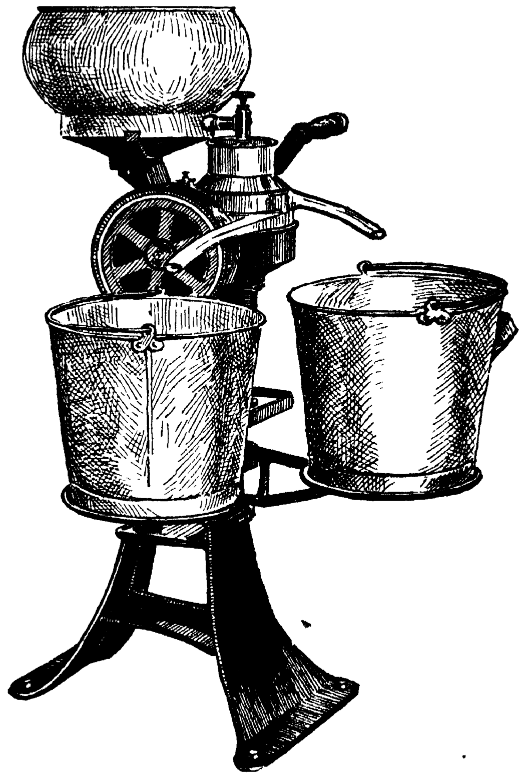


Fig. 166. Hand separator adapted to farm use.

The lactoscope depends on the same principle. A measured quantity of milk is placed in a glass tube having an inner part on which there are black marks. The milk covers the inner part, and water is added until the marks can be seen faintly. The quantity of water is supposed to indicate the richness of the milk. This instrument also is inaccurate, but it is used to a limited extent by inspectors.

About twenty years ago, when the system of buying milk at factories was being rapidly developed, it became necessary to have a quick and accurate method of testing milk for its fat content. Chemists worked diligently on this problem, and numerous ingenious tests were devised. These include the lactobutyrometer, Soxhlet's method, the De Laval lactocrite, Fjord's control apparatus, and the methods of Failyer and Willard, Parsons, Patrick, Cochran, Beimling, and Babcock. Some of these tests were quite satisfactory, but in this country the Babcock test has practically replaced all of the others because of its rapidity, accuracy, inexpensive apparatus, and simplicity. It has been widely adopted also in some other countries. This test was brought out by Doctor Stephen Moulton Babcock, a native of New York state, formerly Instructor in Chemistry at Cornell University, then

Chemist in the New York Agricultural Experiment Station, and since 1888, Professor of Agricultural Chemistry in the University of Wisconsin.

The Babcock method.—In this test, a measured sample of milk is mixed with strong sulfuric acid, which dissolves all of the milk constituents except the fat. The mixture of milk and acid is then subjected to centrifugal force, by which the fat is separated from the heavy liquid and, after the addition of water, the fat is brought into a part of the bottle where it can be quickly measured. The entire test can be made in fifteen to twenty minutes. It is a test which should be used even more widely by milk buyers and those who have authority in connection with milk inspection, as well as by producers themselves.

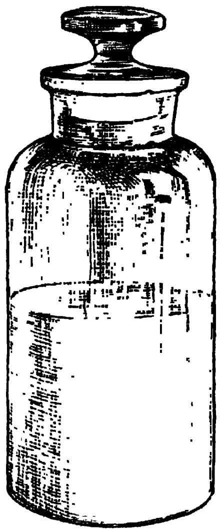


Fig. 167. Milk jar for holding samples.

In detail, the test is made as follows: The milk to be sampled is thoroughly mixed by pouring it several times from one vessel to another. By means of a milk pipette, or measure, graduated to hold 17.6 cc., this quantity of milk is transferred to a special form of bottle, which has a capacity of a little more than one ounce and a long neck with graduations or per cent marks from 0 to 10. The cubic capacity of the neck, from 0 to 10, is exactly 2 cc. This is the volume of 1.8 grams of fat, which is the substance to be measured on the scale. As the bottle is so graduated that 1.8 grams represents 10 per cent, it is necessary to use a sample weighing ten times as much, or 18 grams, and it is found that the 17.6 cc.pipette will deliver approximately this weight of milk. There is then added 17.5 cc.of concentrated commercial sulfuric acid, having a specific gravity of 1.82 to 1.83. The acid and milk are mixed by a rotary motion. The action of the acid on the water and solids of the milk generates considerable heat. The sample is promptly placed in a centrifugal machine and whirled for five minutes. Hot water is then added to bring the fat to the base of the neck. It is then whirled two minutes and more hot water is carefully added until the fat rises in the neck so that it is opposite the graduations. The sample is then whirled one minute, to insure collecting as much fat as possible in the neck. While the fat is still warm, its percentage is ascertained by reading the marks at its upper and lower levels and taking the difference between them.

The cost of a small complete outfit for testing milk is six to ten dollars, and one may be purchased from almost any dairy supply house. An outfit complete is shown in Fig. 168.

The Gerber method of testing milk for fat is used extensively in Germany and Denmark, and is found occasionally in this country. It differs but little from the Beimling method. This test depends on the same principles as the Babcock test. A smaller quantity of milk is used for the sample, and amyl alcohol is added besides sulfuric acid. The amyl alcohol has the effect of assisting to a clear separation of the fat.

Test for formaldehyde.

Formaldehyde is sometimes used as a preservative of milk, although this is unlawful in most states. The general objections to preservatives obtain in this case, and a further objection to formaldehyde is that it renders the casein in milk insoluble, and, therefore, less digestible. Hehner's test for formaldehyde is exceedingly delicate. It is sensitive for one part of formaldehyde to two hundred thousand parts of milk. This test is as follows: To a few cubic centimeters of the suspected milk add a few cubic centimeters of concentrated commercial sulfuric acid, and pour this in carefully, so that it will follow the side of the glass container to the bottom, not mixing with the milk, but forming a distinct layer under it. If a violet color is noticed where the two liquids come together, formaldehyde is indicated; otherwise, there will be no color, or a dark-colored layer, between the milk and acid. In this test the acid should contain some iron-salt, as is usually the case with commercial acid. To make sure of this, however, a little ferric chlorid may be used.

Test for boric acid or borax.

These substances are sometimes used as preservatives. Van Slyke describes a simple test as fol-

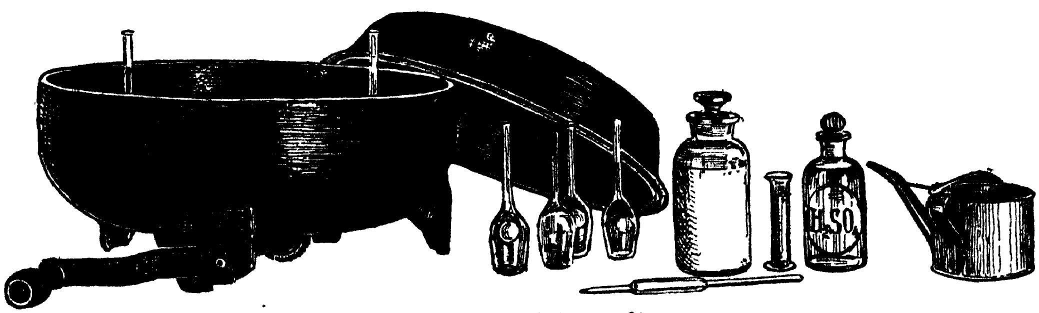


Fig. 168. Babcock test outfit.

lows: Add lime-water to 25 cc. of milk until the mixture is alkaline; evaporate to dryness and burn to an ash in a small porcelain or platinum dish. Add a few drops of dilute hydrochloric acid to the ash, care being taken not to use too much acid, then add a few drops of water, and place a strip of tumeric paper in this water solution. Dry the paper, and if either borax or boric acid is present, a cherry-red color will appear. This test is con-

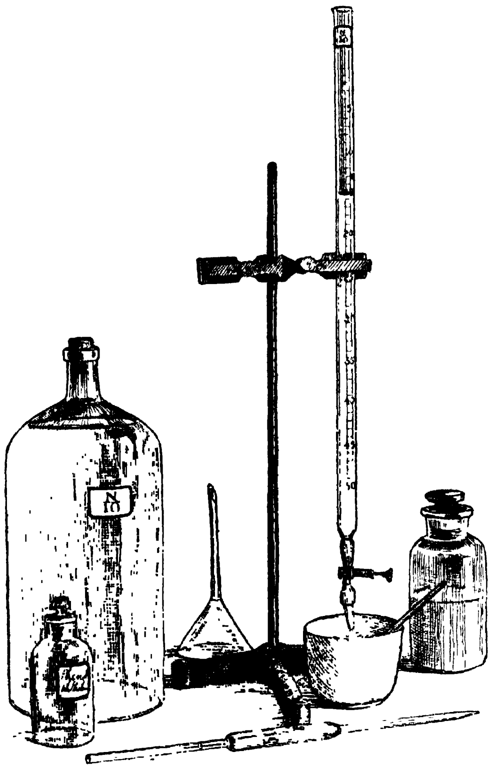


Fig. 169. Mann's acid test outfit.

firmed by moistening the reddened paper with a drop of an alkali solution, when the paper will turn to a dark olive color, if borax or boric acid is present.

Test for coal-tar dyes.

Van Slyke also describes a test for this form of milk adulteration. Add 10 cc. of milk to 10 cc. of strong hydrochloric acid, and mix. A pink color appears if coal-tar dyes have been used.

Test for boiled milk.

It is sometimes desirable to determine whether milk has been subjected to 176° Fahr. or higher heat. A successful test has beeh devised by Storch. To 5 cc. of the suspected milk add a few drops of potassium iodid and a similar quantity of starch solution, also a few drops of hydrogen peroxid. If the milk has not been cooked, an enzyme which is present will decompose the hydrogen peroxid, setting free oxygen. This combines with the potassium salt and thus iodine is in turn set free and with the starch it forms a purple color. If the milk has been heated so that the enzyme is killed, no color will result.

Another test for cooked milk is given by Arnold, as follows: Tincture of guaiac is added, drop by drop, to a little milk in a test-tube. If the milk has not been heated to 176° Fahr., a blue zone is formed between the two fluids. If it has been heated, there is no reaction. The guaiac-wood tincture is said to be more reliable than other tinctures, and it should not be used when fresh, but when at least a few days old and its potency has been determined.

Test for acid.

It is not practicable to isolate lactic acid from milk and measure it as milk-fat is measured. But its quantity can be easily determined by slowly adding to a known quantity of milk an alkali of known strength until all the acid is neutralized. The neutralization is indicated by phenolphthaleïn which was previously added to the milk and which causes the milk to turn pink as soon as it begins to show an alkaline reaction. It is customary (Mann's test, Fig. 169) to use deci-normal alkali solution, 1 cc. of which will neutralize .009 grams of lactic acid. The equipment includes, besides the neutralizer and phenolphthaleïn, a burette for measuring the neutralizer, cup and glass rod. If 20 grams of milk is used and it requires 6 cc. of alkali to neutralize the acid, it is known that the milk contains 6 x .009 or .054 grams of lactic acid or .27 per cent. Alkali tablets (Farrington's), each capable of neutralizing .034 grams of acid, are on the market. They may be used in solution instead of the deci-normal solution. [See page 211.]

The lactometer.

As the specific gravity of milk is markedly changed when it is adulterated by the addition of water or the removal of cream, the lactometer is an important instrument to indicate such adulterations. It is of little use if both kinds of adulteration have been practiced on the same sample of milk, as the increase in weight due to removal of cream can be offset by the addition of water, which is lighter than skimmed milk. In connection with the Babcock test, the lactometer is most valuable, and several formulæ are in use by which the solids not fat or the total solids of milk may be closely computed from the specific gravity and the fat test.

The lactometer is a form of hydrometer adapted especially for use in milk. Several styles are in use, the Quevenne (Fig. 170) being the most convenient because its readings indicate the specific gravity without the necessity of more than a simple mental calculation. The readings on the stem of the Quevenne lactometer are from 15 to 40, and they represent the second and third decimal figures of the specific gravity, the preceding figures always being 1.0; thus, a reading of 29 represents a specific gravity of 1.029. This instrument should be used in milk at a temperature of 60° Fahr. If the temperature varies therefrom a correction of the reading must be made, .1° being added to the reading

for each degree of temperature of the milk above 60°, or the opposite if the temperature is below 60°. Thus, if the lactometer reads 31 at a temperature of 65°, the corrected reading for 60° would be 31.5, and the specific gravity of this milk at 60° would be 1.0315. Special tables for making corrections for different temperatures are published in books treating on the subject. By the rule given, it is not advisable to attempt to correct for a variation of more than 10° from 60° Fahr.

Fig. 170. Quevenne lactometer.

Another style of lactometer in common use is known as the New York Board of Health lactometer. Its graduations are from 10 to 120. The instrument stands at 100 in milk having a specific gravity of 1.029, and it would stand at 0, if graduated to that point, in a fluid having a specific gravity of 1. Thus, it has 100° with the same value as 29° on the Quevenne lactometer, and it is a simple matter to compute the equivalent reading of one lactometer for any given reading on the other by the formula:

$$Q = .29 \text{ B of H, or B of H} = \frac{Q.}{.29}$$

Computing total solids of milk.

Babcock and Richmond have proposed formulæ for computing the total solids of milk. One of the best is:

$$\frac{L}{4} + 1.2F + .14 = \text{total solids.}$$

L represents the second and third decimal figures of the specific gravity, or the Quevenne reading, and F represents the per cent of fat. This formula is used largely, and for practical purposes agrees closely enough with results of gravimetric analysis.

Production of milk.

The production of milk involves two large questions—the cost of production, and the quality of the milk. The first is chiefly a matter of the efficiency of the cows, and the second is chiefly a matter of cleanliness. It is now recognized that any healthy cow, in normal condition, gives milk that is wholesome. Cows of different breeds have their respective advantages, but these are not so great between the leading dairy breeds as is popularly supposed. A matter of larger importance to most dairymen, is the proportion of good dairy blood in their cows. Owing to the lack of this, as well as the lack of good care, there are many unprofitable cows. It is often stated that one-fourth or one-third of the dairy cows throughout the country are kept at a loss—that is, the value of their milk is less than the value of their feed. There are no official figures to confirm this statement, but there are a large number of unofficial figures, which are reliable, and which do show a very large proportion of cows to be "robbers." Some such may be found in most herds. When they are given good feed and care, and with these advantages still fail to produce profits, they should be quickly disposed of. In recent years, an important feature of dairy development in districts where competition is most keen has been the formation of cow-test associations, the chief purpose of which is to see that the production of each cow, and the value of food consumed by each cow in the herds of the members, are carefully recorded for the year. With the accurate information thus provided, it is possible for owners to dispose of the poorest cows, and statistics show that they do this, with the result that the average yield per cow and the average profit per cow have increased. The most progress along these lines has been made in Denmark, where the value of cow-test associations is widely recognized. The movement is now extending slowly to Canada and the United States.

But a great many individual dairymen are learning the value of individual cow records and they are taking advantage of this (best-known) help to develop a herd of good milkers. No judge can pick out the cows of a herd in the order of their own value as milk-producers, as a record will enable one to do.

The only requirements are a spring-balance, a sheet ruled for dates and cows' names, a lead-pencil, and a milk-testing outfit. For practical purposes, it is sufficient to weigh the milk only one morning and evening per week, and from these weights compute the total milk-yield. It is sufficient, also, to make a composite sample test only once in two weeks, for computing the fat-yield. In many dairies the milk of each cow is weighed twice daily. Not a few dairymen have begun by making occasional records of their individual cows, and have found this so satisfactory that they want the records as complete as possible.

At the present time there is a widespread and increasing demand for cleaner milk. This demand comes from those who are manufacturing butter and cheese, but more especially from milk consumers in cities and towns, and is shown chiefly by the enactment of laws and ordinances demanding specific improvements. Some of these improvements can be put into effect at low, or no extra cost on the part of the producer. Others are less easy to provide. All of them require more intelligence than is needed in the production of ordinary dirty milk, and for this reason, if no other, the adoption of sanitary improvements in dairies should be rewarded by some increase of the selling price of the milk.

In the production of sanitary milk, the different points to be carefully safeguarded may be grouped under five headings:

(1) The first is the health of the herd. An animal that is diseased is likely to give unwholesome milk. Her milk may contain germs of disease, whether the disease is established in the udder tissue or not. Tuberculosis is the principal disease

that causes trouble. It develops in an insidious manner and cannot always be recognized by physical examinations. Many progressive cattle-owners now accept the scientific teaching that the best method to assure against the presence of tuberculosis in a herd is to depend on the tuberculin test (page 136). It should be applied by a competent veterinarian, at intervals of one or two years, and oftener when there is a special reason. An animal suffering from tuberculosis should be isolated from the remainder of the herd, because of the danger of this animal to the others, as well as because the milk may be infected. Other diseases to which cows are subject are more or less common, but they are easily recognized.

For the protection of the health of the herd, it is important to provide an abundance of light and ventilation in the stable. It has been attempted to formulate rules for these essentials, but thus far no better rules have been proposed than that the cow stable shall have as much daylight as the dwelling-house, and it should be so well ventilated that the air will at no time be oppressive to one who enters from out-of-doors.

The quality of food and water may have an effect on the health of the cows, and thus indirectly on the value of the product. Especially must care be taken to avoid foods that are not in wholesome condition, such as certain by-products of breweries and distilleries when these are allowed to remain wet and become considerably fermented before use. It is necessary, also, to avoid giving any single food in excessive quantity.

(2) The second requirement for the production of sanitary milk is cleanliness of the cows and their surroundings. This implies a reasonable degree of scientific cleanliness in the stable. The stable and cows must be cleaned frequently, but not just before milking-time, when the air should be kept as free as possible from dust. It is well to clip the long hairs from the udder and surrounding parts. A common mistake is to allow the stable air to be filled with dust of hay or other dry feeds just before milking. The small particles of dust carry enormous numbers of bacteria, which, falling into milk, find satisfactory conditions for rapid growth.

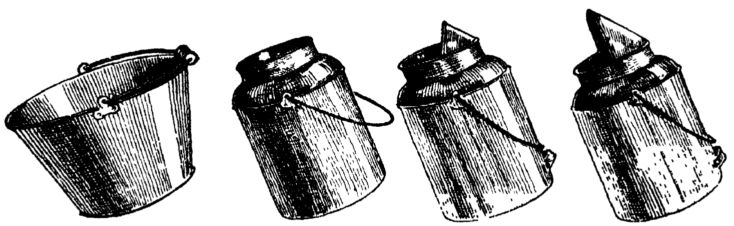


Fig. 171. The ordinary milking pail; the "milk kettle," which makes a good small-top milking pail, and same with low and high visors, further to reduce size of opening through which dirt may fall.

At the Cornell Agricultural Experiment Station, it was found that more than 5,000,000 bacteria fell into an open milk can when it was exposed seven minutes in a stable in which the air did not contain an excessively large quantity of dust. It was shown also that a large amount of contamination by bacteria occurs from fine particles of dirt dropping from the udder into the pail at the time of milking. When the udder and surrounding parts were wiped with a damp cloth, contamination from this source amounted to less than four per cent of what it was when the udder had been carelessly brushed before milking. A fly falling into the milk may introduce as many as 1,000,000 organisms. A cow's hair was found to carry 26,000 bacteria, and a small piece of hay that dropped from the cow's body was found to carry more than 150,000 bacteria.

(3) The third requirement refers to the utensils and their care. They should be constructed in such a way as to make cleaning easy. This demands freedom from sharp corners and cracks, and places that can not be reached by a brush. They should be sterilized after cleaning, an operation that is usually neglected. At the Cornell Agricultural Experiment Station, old milk was placed in several different pails. These were cleaned with different degrees of thoroughness, and clean, fresh milk was put into each one. It was found that the pail that had been cleaned only by rinsing with cold water contaminated the fresh milk to the extent of 130,000 bacteria per cubic centimeter. The pail carelessly washed and rinsed with warm water furnished nearly 15,000 bacteria per cubic centimeter to the milk it contained; while those carefully washed and sterilized furnished only a few hundred, or practically no bacteria per cubic centimeter.

(4) The fourth point requiring attention is the health and manner of work on the part of the employees. Typhoid fever and other human diseases are easily carried by milk, if the organisms get into it; hence the importance of insisting on good health of those who handle milk. The milk handlers also should wear special overall clothes for their work. In the highest class dairies, white overalls are worn and these are frequently washed and often sterilized. Special attention also is given to the cleanliness of the milkers' hands and to their care to keep the hands dry when milking.

(5) The fifth point is the handling of the milk, which means its prompt and efficient cooling, and its storage at low temperature until used. The accepted limit to which market milk should be cooled is now 50° Fahr., and it should be cooled more than this when practicable. Some cities have rigid requirements on this point. In New York, the inspectors may dump into the gutter milk having a temperature above 50° Fahr.

The above items have been arranged in their order, with sub-headings and numerical values, on a score-card which was proposed by the writer before the Syracuse Farmers' Club in February, 1905. This score-card, with slight modification, follows, together with a statement showing what constitutes perfect under each heading. Such a card has been shown to be of value in city milk-inspection work. It points directly to and shows the gravity of faults in equipment and methods:

Department of Dairy Industry, College of Agriculture, Cornell University.

Score-card for Production of Sanitary Milk.

Date________ Dairy of________ P. O.________

		Perfect	Score	Defects
I. Health of the herd and its protection.	Health and comfort of the cows and their isolation when sick or at calving time	45		
	Location, lighting and ventilation of the stable	35		
	Food and water	20		
	Total	100		
II. Cleanliness of the cows and their surroundings.	Cows	30		
	Stable	20		
	Barnyard and pasture	20		
	Stable air (freedom from dust and odors)	30		
	Total	100		
III. Construction and care of the utensils.	Construction of utensils and their cleaning and sterilizing	40		
	Water-supply for cleaning and location and protection of its source	25		
	Care of utensils after cleaning	20		
	Use of small-top milking-pail	15		
	Total	100		
IV. Health of employees and manner of milking.	Health of employees	45		
	Clean, over-all milking suits and milking with clean, dry hands	30		
	Quiet milking, attention to cleanliness of the udder and discarding foremilk	25		
	Total	100		
V. Handling the milk.	Prompt and efficient cooling	35		
	Handling milk in a sanitary room and holding it at a low temperature	35		
	Protection during transportation to market	30		
	Total	100		
	Total of all scores	500		

If the total of all scores is	And each division is	The sanitary conditions are
480 or above	90 or above	Excellent
450 or above	80 or above	Good
400 or above	60 or above	Medium
Below 400	Or any division is below 60	Poor

The sanitary conditions are________ Scored by________

BRIEF DESCRIPTION OF WHAT CONSTITUTES "PERFECT" UNDER EACH HEADING OF ABOVE SCORE

I. *Health*. No evidence of chronic or infectious disease or of acute disease in any member of the herd on the dairy premises. Freedom from tuberculosis proved by the tuberculin test made within one year.

Comfort. Protection from weather extremes. Stall comfortable—at least three feet wide for a small cow, or three and one-half for a large cow; length of stalls sufficient for cows to rest easily. Sufficient bedding. Frequent outdoor exercise.

Isolation. Removal of cows to comfortable quarters outside of the dairy stable, when sick or at calving time.

Location of stable. Elevated, with healthful surroundings.

Lighting. As light as a well-lighted living-room, and with not less than four square feet for light from the east, south or west, for each cow.

Ventilation. An adequate ventilating system of the King or other approved pattern, and, except when the stable is being cleaned, no marked stable odor.

Food. Clean, wholesome feeding-stuffs, fed in proper quantities.

Water. Clean, fresh water, free from possibility of contamination by disease germs.

II. *Cows*. Cleaned by thorough brushing, and, when necessary, by washing; no dust or dirt on the hair (stains not considered). The udder thor-

oughly cleaned by brushing at least thirty minutes before milking, and, by washing just before milking, leaving the udder damp to cause dust to adhere. Hair clipped on udder and flanks.

Stable. Free from the accumulation of dust and dirt except fresh manure in the gutter. Apart from horses, pigs, privy, poultry-house, etc.

Barnyard and pasture. No injurious plants, no mudhole or pile of manure, or any decaying substance where cows have access.

Stable air. Free from floating dust and odors. Tight partition or floor between the space occupied by cows and that used for storage of feed or other purpose. Floor dampened before milking.

III. *Construction of utensils.* Non-absorbent material, and every part accessible to the brush, and, except inside of tubes, visible when being cleaned.

Cleaning. Thorough cleaning with brush and hot water, and rinsing each utensil in clean water. No laundry soap. Thorough sterilization in special apparatus.

Water,—from a source known to be pure; protected from contamination from seepage or surface drainage.

Care of utensils. Such as to avoid contamination by dust as well as by coarser dirt.

Small-top pail,—with opening not over seven inches in diameter, and at least one-third of this opening protected by hood.

IV. *Employees,*—free from contagious disease and not dwelling in nor frequenting any place where contagious disease exists.

Milking suits,—freshly laundered and clean; ample to protect from dust and dirt from the milker's person or clothing.

Milker's hands. Hands and teats dry when milking. Hands thoroughly cleaned before milking each cow. Wash basin and clean towel in stable or milk-room.

Milking quietly,—so as to avoid dislodging dirt from cow's hair. At least four streams of foremilk from each teat to be discarded into a separate vessel.

V. *Cooling.* Cooled within fifteen minutes of milking, to temperature below 45° Fahr.

Handling,—in a room used exclusively for handling milk, and free from dust, dirt and odors; and the milk after being cooled, always at a temperature below 45°.

Protection during transportation. Protected from dirt by tightly closed receptacles, temperature always below 45° Fahr.; not delayed in transit, reaching market within twenty-six hours after milking.

Fermentation test.

The fermentation test is sometimes useful to show the result of objectionable bacteria present in excessive numbers. A few ounces of milk is placed in a clean glass jar and coagulated by rennet. It is held at about 90° Fahr., and the whey drained off. When the curd has shrunken and become fairly firm, it is examined. It should be free from holes and without bad odor. These faults are roughly in proportion to the contamination.

Pasteurization of milk.

Pasteurization is the destruction by heat of a large proportion of the micro-organisms in milk. The principal advantage of this treatment, from the commercial standpoint, is the improvement resulting in the keeping-quality of the milk. From the standpoint of the hygienist, the advantage of pasteurization is chiefly in the fact that this treatment can be depended on to destroy pathogenic organisms. The practice of pasteurization is rapidly increasing in certain places, but it is making no progress in others, because of strong opposition. Among the arguments against pasteurization is the fact that this treatment does not kill all the organisms in milk but only those which are most easily destroyed, and these include the relatively harmless lactic-acid forms and do not include some of the most harmful putrefactive bacteria which have the property of producing resistant spores. Thus, after milk has been pasteurized, it may contain only a small number of organisms, but all, or practically all of these, may be highly objectionable types. If, then, the milk is exposed at temperatures favorable to bacterial growth, or held a considerable length of time at a fairly low temperature, these few bacteria have an opportunity to grow without the checking influence of other forms. They may increase to such an extent as to injure seriously the quality of the milk without giving any outward sign of their action, such as is occasioned by the growth of lactic-acid bacteria, which cause milk to become sour. Milk that is heavily loaded with harmful but unobserved organisms may cause serious disturbance in the digestive tract. Another strong objection to pasteurization is on the ground that the work is often poorly done; and it is true that in some places the so-called pasteurization is conducted in a most careless manner, the pasteurized milk actually containing a larger number of bacteria than it contained before heating. This is due to careless methods throughout: the use of improperly cleaned utensils, the use of insufficient heat, delay of cooling and insufficient cooling, and unnecessary exposure of the milk. It is needless to say that in such cases the milk is not desirable for food purposes.

The chief value of pasteurization is at times when there is a general outbreak of a contagious disease, when it is not known but that persons handling the milk are affected with the disease. In all such cases, the milk should be pasteurized, and, after treatment, protected with the utmost care to assure no further infection.

Probably the most resistant of the pathogenic organisms that are likely to be in milk is the bacillus of tuberculosis. To kill these germs, milk must be heated to 150° for thirty minutes, or 157° for fifteen minutes, or 167° for ten minutes, or to 180° momentarily. It has lately been shown, however, by Smith and Russell, that it is sufficient to heat the milk only to 140° for twenty minutes, provided it is heated in closed receptacles. For market-milk purposes, this lower temperature is preferred because it is not accompanied by the cooked flavor, which is objectionable to many persons.

An essential part of the work of pasteurization consists in cooling the milk. The operation really is not completed until the milk has been cooled to a point below 50°, at which bacteria grow but slowly.

There are many different forms of apparatus for use in pasteurizing milk. They may be divided into two general classes,—those for treating the milk in bulk, and those for treating it continuously. (1) The former method would be employed in a household and is used in a few commercial plants. It consists of placing the milk in a receptacle that is surrounded by hot water or steam. The temperature of the milk is raised to the required point, held there the required length of time, after which the milk is cooled. With this method one has perfect control of all conditions, and for this reason it is more thorough than the continuous method. Very simple, inexpensive equipment may be used,—even ordinary kitchen utensils, such as a small tin pail standing in a pan of hot water which is placed on the stove. It is essential to have an accurate thermometer; the best form is the glass floating thermometer which can be easily cleaned. (Fig. 173.)

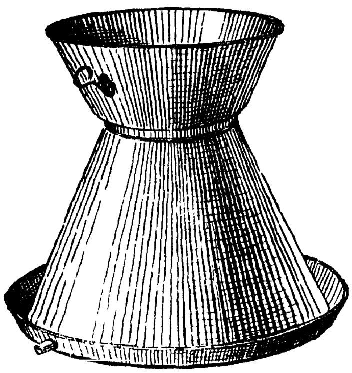


Fig. 172. Milk-cooler.

(2) The continuous pasteurizers perform their work continuously and usually are arranged to heat the milk and at least partially to cool it, a stream of milk flowing through them constantly so long as the operation is in progress. There are several different styles of these machines. All are constructed so that the milk is separated from the hot water or steam by a thin sheet of metal, usually copper covered with tin. (Fig. 242.)

One of the latest improvements in pasteurizers is known as the regenerative feature. With this the milk-flow within the machine is so arranged that the heated milk which needs to be cooled is separated from the cold milk which has just entered and needs to be heated, by a thin metal plate through which considerable heat readily passes. Thus there is a large saving of required heat units and an equal saving in the cooling. (Fig. 243.)

An improvement on continuous pasteurizers, which has been exhibited very recently, consists of a series of reservoirs arranged as the sectors of a circle. These are filled with hot milk, one after another, and when the last of the sector spaces is being filled the first one, which stands adjacent, is being emptied and its milk is on the way to be cooled, and this space is ready to be filled again by the time it is needed. Thus, all of the milk is heated to the desired temperature and held at that temperature as long a time as is required for all of the sector spaces to be filled, and this is under control.

One of the practical difficulties in connection with the pasteurization of milk, and especially the pasteurization of cream, lies in the fact that the heating of milk or cream causes it to become more fluid, or to "lose its body." This is due, probably, to the tendency of fat globules to break away from their irregular clusters in which they gather in raw milk and distribute themselves evenly throughout the entire mass, causing it to flow more easily. Babcock and Russell have proposed the use of viscogen to remedy this difficulty in cream Van Slyke's recipe for this substance is, —"To one pound of water add one pound of any pure cane-sugar and dissolve. Then add an excess of fresh quicklime in small chunks about the size of ordinary marbles; stir occasionally until the action is completed. Let the sediment settle and pour off the clear liquid. Keep in tightly-stoppered bottles." This should be added to pasteurized cream at the rate of one part of solution to 100 or 150 of cream.

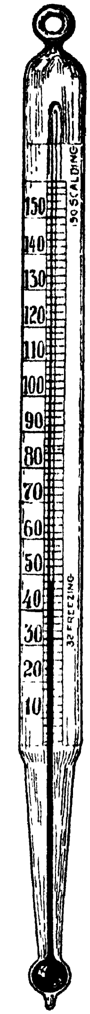


Fig. 173. Glass floating thermometer for dairy use.

Market milk.

Milk contains all the necessary food constituents. It is palatable, digestible, nutritious, and cheap. The market milk industry, which includes the preparation, transportation, and sale of milk for use in the household, has been rapidly developed with the increasing size of cities and towns. The territory from which market milk is drawn may be divided into three districts or zones: (1) the city itself, where dairies are often found, and where much of the poorest milk is produced. Perhaps the chief reason for the poor quality of milk produced in the city is that the cows do not have clean, roomy pastures, and they are usually kept in cramped quarters; but another reason of importance is that the food given the cows in city dairies is often of a character that should not be used and can not profitably be transported to the country. (2) The second zone is a band of territory about ten miles wide, surrounding the city, and from which milk is brought in the wagons of the producers. (3) The third district is all the territory beyond. In the case of large cities, most of the milk comes from this last district. Trains carrying milk originate about four hundred miles from New York City. It is safe to say that the milk from the third district runs as good in quality as that from any other. The delay because of long hauls requires extra care in cooling and handling. As a rule, milk shipped by railroads reaches the cities in time for it to be delivered when twenty-four or thirty-six hours old.

Most of the large shippers to New York, and some other cities, now have stations along the rail-

roads where milk is received and prepared for shipment. For New York, these used to include bottling facilities, but the railroad rates having been raised on bottled milk, it has had the effect of bringing about the shipment of milk in cans and bottling in the city. At present the ruling rates for transportation of milk on railrords running into New York City are as follows:

From stations within 40 miles of New York City, 23 cents per 40-quart can.
From stations within the next 60 miles, 26 cents per 40-quart can.
From stations within the next 90 miles, 29 cents per 40-quart can.
Beyond this distance, 32 cents per 40-quart can,

Milk in bottles is usually charged 40 per cent above these rates. One car carries 200 to 325 cans. About 1,000,000 cans are carried each month.

Prices paid to farmers for market milk vary from about two to three cents per quart in the summer, and from about three to four cents in the winter months. The retail price in cities is generally eight cents per quart, but in the past year there has been a tendency to increase, so that the regular price in some cities is now nine cents. Milk is often sold at lower rates at stores, and this is possible because of the saving of heavy delivery charges. In this business, as in others, there are usually a few firms that cut under the regular price and are more or less uncertain in the quality of their product, as well as their reliability. The retail price in towns is generally five to seven cents per quart.

The prices paid to producers for their milk are announced in advance by some concerns which have a definite contract with their producers and agree to pay stated prices each month for a period of six months after the date of the contract. These agreements also govern the manner in which milk shall be produced and handled. A very large part of the milk, however, is bought on the basis of prices which are announced by an organization composed largely of dealers, and which changes the price from time to time, as conditions of supply and demand seem to require. As a general rule, the relation between this price for one quart of milk and the value of one pound of butter, is about as 1 is to 8.2. Occasionally the price of butter is ten times as high as the price for one quart of milk, and on the other hand, in the fall of the year, when milk for the city is scarce, the price of butter may be only about seven times the price of milk.

Most states have general laws relating to foods, and some of them have special laws relating to milk. Most cities have special milk ordinances. These commonly require at least 3 per cent of fat in the milk and at least 12 per cent total solids. The remaining requirements of the laws, as a rule, are indefinitely stated and rarely enforced. It must be said, however, that within the last few years a few cities have adopted rigid regulations which refer to the manner of producing and handling milk, and are enforcing these regulations to a limited degree. This movement in the interest of more sanitary milk is in direct accord with the movement for more sanitary conditions generally.

Standard milk.

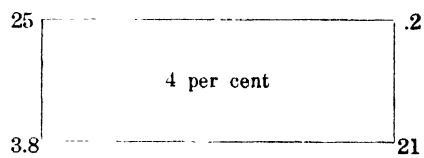
Standard milk is that conforming to the legal requirements.

Standarized milk.

Standardized milk is milk which has been changed in its composition to cause it to contain a required amount of fat. This is usually done by adding cream or skimmed milk. A convenient rule for determining the amount of ingredients to make a mixture testing a certain per cent of fat, is as follows, supposing cream and milk are to be used (in most states it is unlawful to add skimmed milk):

Draw a rectangle, placing the per cent of fat in the cream at the upper left-hand corner, and the per cent of fat of the milk at the lower left-hand corner. Place the desired per cent of fat in the center. The difference between the numbers in the center and at the lower left-hand corner should be written at the upper right-hand corner, and the difference between the numbers in the center and at the upper left-hand corner should be written at the lower right-hand corner. These right-hand numbers represent the proportions of the substances represented at the corresponding left-hand corners which must be mixed to produce a milk testing the desired amount of fat. Thus:

To raise the fat test of a 3.8 per cent milk to 4 per cent by the use of cream testing 25 per cent, by completing the figure as explained, it will be seen that for every twenty-one pounds of 3.8 per cent milk there should be used .2 of one pound of 25 per cent cream.



Certified milk.

This term is applied to milk that is produced by special agreement under certain strict regulations as prescribed by a milk commission, which certifies to the high quality of the product. Usually the commission is composed largely or entirely of medical men and they depend on four experts,—a veterinarian, chemist, bacteriologist and physician. This milk is used principally for infant feeding. It commonly retails for ten to eighteen cents per quart.

Modified milk.

This term refers to cow's milk which has been so changed in its composition as to meet the requirements of young babies. It is used very largely for feeding infants whose mothers are unable to nurse them. Modified milk laboratories are established in some of the larger cities, and there physicians send prescriptions for milk-feeding, the same as they would send prescriptions for medicines to a drug store. Modification is practiced extensively, also, in homes, but with less accurate results. Modifying is done with the aid of tables

or set rules which show the amounts of cream, skimmed milk, sugar solution, distilled water and lime-water necessary for mixtures of different composition.

Milk beverages.

These include Kumyss, Kephir, Zoolak and Youghort, which are now made from cow's milk. All are the products of fermentation generally produced by yeasts and bacteria. In some cases sugar is added and a small amount of alcohol is formed. The popularity of these beverages seems to be increasing slowly. This is partly due to statements of some European medical authorities that they are healthful and may be the means of prolonging life.

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BACTERIA OF MILK

By *W. A. Stocking, Jr.*

The relation existing between bacteria and the handling of all milk products is an intimate one; in fact, nearly all of the processes of handling milk and cheese, and to a large degree of butter also, are based on the action or the control of bacteria. The nature of milk makes it preëminently an ideal habitat for most forms of bacteria, and because of the almost universal occurrence of these minute organisms, milk produced and handled under ordinary conditions becomes planted with large numbers of them.

Nature of bacteria. (Fig. 174).

Bacteria belong to that great group of the lower plants known as fungi. Each individual plant consists of a single cell filled with protoplasm. They are microscopic in size, and without any of the green color common in the higher plants. In form they are the simplest known plants, and are therefore classified at the bottom of the scale of plant life. [See p. 441, Vol. I.]

Because of the fact that these minute plants contain no chlorophyl, they are not able to feed on the mineral substances on which the higher green plants grow, but must have more highly organized substances, thriving best on nitrogenous organic compounds, as proteids and albumen, and on starches and sugars.

Like the higher plants, they can absorb their nourishment only in solutions, and even when living on solid substances their food must be made soluble before it can be taken into the bacterial cells. Bacteria need a liberal amount of moisture in order to grow rapidly. Most species thrive best in liquids, and, if gradually deprived of moisture, they grow more and more slowly, and finally cease growing altogether when the material in which they are living becomes moderately dry.

Heat is also essential to the growth of bacteria. Different species vary considerably as to the temperature at which they will make their maximum growth, but most of the common dairy bacteria develop rapidly at temperatures between 50° and 100° Fahr. The optimum temperature for the growth of most of the common species lies between 70° and 95° Fahr.

Any one familiar with the composition of milk will at once see that it supplies all the conditions necessary for rapid bacterial growth. Not only does milk contain all the necessary materials for nutrition, but these are in such form that they are easily appropriated by the bacteria. The albumen, being in solution, is easily taken up by the cells; the milk-sugar is also an excellent food, and, while the casein cannot be used directly, it is made use of by those organisms which produce enzymes, whose action renders the casein soluble.

How bacteria get into milk.

When milk is secreted in the glands of a healthy udder, it contains no bacteria. It does not, however, remain long in this sterile condition. Normally, the cavities and milk ducts in the udder contain a more or less abundant bacterial flora. These organisms become disseminated through the milk as soon as it is elaborated, and as a result of this condition milk normally contains greater or less numbers of bacteria when it is drawn from the cow. It is, however, after leaving the cow that it receives its greatest bacterial contamination. Even if much care is taken in keeping the stable free from dust, and the cows clean, and the milkers

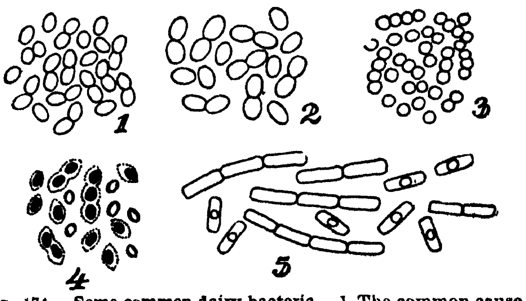

Fig. 174. Some common dairy bacteria. 1, The common cause of sour milk, *Bacterium lactis acidi*; 2, a gas-forming lactic bacterium, *B. lactis aerogenes*; 3, a coccus found in milk; 4, *B. lactis viscosus*, the cause of ropy milk; 5, a putrefactive, spore-forming bacillus.

exercise considerable care, it is impossible to prevent a certain number of organisms falling into the milk at the time of milking. By the exercise of extreme precaution, the number of bacteria thus getting into the milk may be reduced to a compar-

atively small number, but when little care is exercised, and uncleanly conditions exist, *the milk commonly becomes heavily planted with a variety of species of bacteria. Considerable numbers may also get into the milk from the dairy utensils if they have not been properly cleansed and sterilized.* Exposure at any point between its production and consumption may very materially increase the bacterial contamination of milk.

It may be seen from the above statements that milk may become contaminated with organisms normally living in the udder at body temperature; from the exterior of the cow; from the stable atmosphere; from the stable filth, either directly or indirectly, having passed first into the atmosphere of the stable, and thus falling into the pail; from the hands or clothing of the milker; or from the water that is used for the washing of the dairy utensils. As a result of the large number of sources from which these minute organisms get into the milk, we commonly find a considerable variety of species, the types and numbers depending on the conditions under which the milk was produced.

With the exception of the putrefactive organisms which get into the milk from the stable, these various species are not known to be harmful, while some are beneficial in important dairy operations. If, however, the cow is suffering from certain forms of disease, or a person who is affected with, or is closely associated with human diseases, such as tuberculosis, typhoid fever, scarlet fever, handles the milk, or if the dairy utensils are washed with water which has been contaminated with the organisms of disease, the milk may contain the germs of that specific disease, and be a source of danger to those who consume it.

Normal development of bacteria in milk.

When milk first leaves the cow, as has already been said, it commonly contains a considerable variety of species of bacteria. These will normally include a small number of acid-producing organisms, some of which may form gas. There may also be a certain number of putrefactive bacteria, together with a variety of miscellaneous species. If such a sample of milk is taken, and the bacterial flora studied at intervals of a few hours, it will be found that the total number of organisms decreases during the first few hours after the milk has been drawn from the cow. This decrease is due to the fact that some of the miscellaneous species that get into the milk do not find the conditions there suitable for their development, and, therefore, die out during the first few hours. It will be noticed, also, that, while the total number of organisms is decreasing, certain species which existed in very small numbers at the outset are increasing constantly from the very start. After a time, the total number of organisms in the milk begins to increase more or less rapidly, depending on the temperature at which the milk is kept. At this point, it will be found that the increase in numbers is due to the rapid development of the acid organisms. Some of the miscellaneous species may also be increasing along with the acid-producing species, while others *may still be decreasing in numbers.* A *little later it will be found that the acidity of the milk has begun to increase, and continues to increase until the milk becomes sour and curdles.* Subsequent examinations will reveal the fact that the rapid increase of bacteria, commonly up in the millions per cubic centimeter, is due almost entirely to the rapid development of the acid-producing organisms, which gain not only in actual numbers, but also in percentage as compared with the other species present in the milk. This rapid development of the

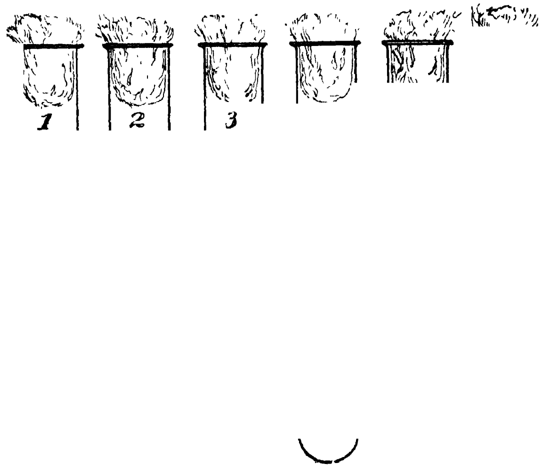

Fig 175. To illustrate the character of growth of some common dairy bacteria in gelatin stab cultures.

acid organisms continues until the milk becomes sour and curdles, when it is found that they constitute at least 99 per cent of all the organisms present. Briefly stated, therefore, the normal development of bacteria in milk is as follows: the milk contains at the outset a variety of different species of bacteria, with the acid-producing ones very much in the minority. Some of the miscellaneous species, not finding the milk suitable for their growth, gradually die out. The acid organisms, which do find the milk specially suited to their requirements, develop rapidly from the first, and by the changing of the milk-sugar into lactic acid, gradually prevent the growth of other species, and constitute at least 99 per cent of all the bacteria at the time the milk curdles.

Abnormal development of bacteria in milk.

Under conditions favorable for them, other types of bacteria may get into the milk in such numbers that they will produce abnormal conditions in it. Sometimes gas-producing bacteria develop to such an extent that they cause very serious troubles, especially in connection with the manufacture of cheese. Certain bacteria produce a bitter taste in milk and cream, often causing considerable trouble, especially in cream used for direct consumption. Sometimes milk becomes slimy when it is a few hours old. This condition is caused by the development of certain species of bacteria, and such milk is known as "ropy" or "stringy" milk. Occasion-

ally a sample may develop a soapy condition, and a number of other abnormal conditions may be produced by the development of different species of organisms.

The problems of those who handle milk, or its products, are to prevent the entrance of the undesirable organisms into the milk, or, having once gained entrance, so to control their development that they will not produce undesirable results. To prevent the entrance of bacteria into milk, much care and cleanliness must be exercised from the time the milk leaves the cow until it is consumed, but having once gained access to the milk, their development can be controlled either by keeping the milk constantly at cold temperatures, or by raising it to a high temperature for a short period and then cooling and holding at a low temperature. This latter process is known as pasteurization. [See page 184.]

Methods of studying bacteria. (Figs. 175–178.)

It frequently becomes necessary to study the different species of bacteria that may exist in any given sample of milk. For this purpose, what is known as the "plating" method is commonly used. This method consists in diluting a given quantity of milk with sterile water, and then placing a given amount of this milk dilution in materials suitable for the development of the bacteria in a flat glass dish. For this purpose bouillon is commonly used, to which has been added a sufficient amount of gelatin, or similar material, to cause it to solidify when cool. This material can then be heated sufficiently to make it liquefy, when the milk dilution containing the bacteria is added and thoroughly mixed. On cooling, the bacteria that were in the milk are fixed in definite positions in the plate. These plates are then allowed to stand for a time, during which the bacteria develop, producing small spots or colonies where each organism was located at the time the plate was made. By counting these colonies and multiplying by the dilution used, the number of bacteria in a given quantity of the original sample of milk can easily be determined.

This is illustrated by the following example: The sample of milk to be tested is thoroughly mixed, and one cubic centimeter drawn out by means of a sterile pipette, and placed in a bottle containing thirty-nine cubic centimeters of sterile water. This gives one part of milk in forty parts of the dilution. After thoroughly mixing by shaking, one cubic centimeter of this dilution is removed with a clean sterile pipette, and placed in another bottle containing ninety-nine cubic centimeters of sterile water, giving a dilution of one part of milk in four thousand parts of the dilution. After thoroughly mixing, one cubic centimeter of this second dilution is placed in each of two test-tubes containing culture media, which are then thoroughly mixed and poured out into culture dishes Nos. 1 and 2, and allowed to solidify. Now another cubic centimeter from the first dilution bottle is added to the second to make a dilution of practically one part of milk in two thousand parts of the dilution, and plates Nos. 3 and 4 made as before. Similarly, plates Nos. 5 and 6 are made from a dilution having one part of milk in one thousand. After the bacteria have developed sufficiently, the number of colonies in each plate is counted, and the average obtained as follows:

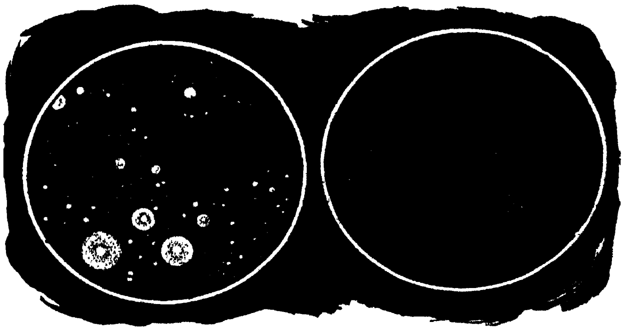

Fig. 177. Bacterial growth from milk kept for twelve hours at different temperatures,—at 70° F. on the left, at 50° on the right.

No. of plate .	1	2	3	4	5	6
Dilution . . .	4,000	4,000	2,000	2,000	1,000	1,000
No. of colonies	44	46	89	90	180	182

$$
\begin{aligned}
44 \times 4{,}000 &= 176{,}000\\
46 \times 4{,}000 &= 184{,}000\\
89 \times 2{,}000 &= 178{,}000\\
90 \times 2{,}000 &= 180{,}000\\
180 \times 1{,}000 &= 180{,}000\\
182 \times 1{,}000 &= 182{,}000\\
\hline
1{,}080{,}000 \div 6 &= 180{,}000
\end{aligned}
$$

Average number of bacteria per cc. of milk, 180,000.

This shows that the milk contained 180,000 bacteria per cubic centimeter at the time the test was made.

Sometimes a different method, known as the "centrifugal" method (Fig. 178), is used for determining the bacteria in milk. This consists in placing a given amount of milk in a tube and whirling it violently with sufficient force to throw the bacteria to the bottom of the tube. The sediment thus

Fig. 176. Bacterial growth from milk produced and handled under different conditions of cleanliness. Both samples are the same age.

obtained is then transferred to a slide, stained, and studied under the microscope, where the individual bacteria can be seen.

Leucocytes in milk.

The microscopic examination of milk by the centrifugal method has revealed the fact that milk frequently contains varying numbers of leucocytes. This has resulted in the adoption by some city boards of health of a numerical standard for the leucocyte content of milk, and the condemning of milk that contains leucocytes in excess of the standard. Wherever inflammation and pus exist, leucocytes, or white blood corpuscles, are present in very large numbers, and it has been found in certain cases that milk coming from diseased udders shows a large leucocyte content. For this reason a large number of leucocytes in any given sample of milk is regarded as indicating inflammation in the udder producing it. On the other hand, recent investigations indicate that normal milk contains a certain cellular content as a result of the normal processes of milk elaboration. With the present methods of examination, it is difficult to distinguish these normal cells from true leucocytes. It is also a question as to where to draw the line between a normal and an abnormal number of leucocytes in milk. Until further research throws more light on the real significance of the cellular content of milk, and better methods for their study have been worked out, this method of determining the wholesomeness of milk cannot be regarded as entirely satisfactory.

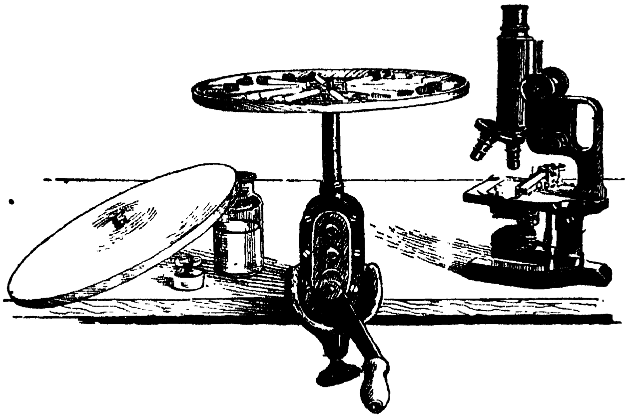

Fig. 178. Centrifuge and microscope for the study of bacteria.

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MANUFACTURE OF CONDENSED MILK

By *O. F. Hunziker*

Condensed milk is milk from which a considerable part of the water has been evaporated. It is primarily of two kinds,—sweetened and unsweetened.

Sweetened condensed milk is preserved with cane-sugar, which is added to the milk before evaporation. If manufactured properly, it will keep for years, but it is best when fresh. It is put on the market in hermetically sealed tin cans and in barrels. The cans vary in capacity from eight ounces to twenty ounces; the fourteen-, fifteen- and sixteen-ounce cans are the most popular. These are shipped in cases holding forty-eight cans and sell for three to six dollars per case, according to size of cans, season of the year and reputation of brand. The sweetened condensed milk in barrels is sold to bakeries and candy and caramel factories at four to seven cents per pound, the price being governed by the percentage of fat and the local market conditions.

Unsweetened condensed milk, sold under the names "evaporated milk" or "evaporated cream," is preserved by sterilization with steam under pressure. If placed in hermetically sealed cans, it keeps indefinitely. It reaches the market in hermetically sealed tin cans, holding eight ounces to one gallon, and sells for two to four and one-half dollars per case. Unsweetened condensed milk, sold as "plain condensed bulk milk," is not sterile and will keep for six to ten days only. It is sold partly to the direct consumer in ordinary milk bottles, and partly in large (forty-quart) milk cans to ice-cream manufacturers. The price varies from twenty-five to sixty-five cents per gallon, according to the percentage of fat it contains.

The quality of the fresh milk is the first and all-important requisite in the manufacture of a marketable and wholesome condensed milk of any kind.

History and development of the industry.

In direct contrast to the slow and gradual evolution of the ancient branches of dairying, stands the more modern innovation and rapid development of the condensed-milk industry. This branch of dairy manufacture was not developed on the farm, nor can its origin be traced far back, and

yet, within the last few decades it has assumed such proportions that today it occupies a prominent place among the leading branches of dairying.

The condensed-milk industry was introduced at the same time as the factory system of butter- and cheese-making, though for many years before the invention of a successful process of condensing milk some method had been sought for preserving it. The American, Gail Borden, the inventor of the manufacture of condensed milk and the father of the condensed-milk industry, is said to have experimented for some ten years, when he finally decided that a semi-liquid state was the best form of milk preservation. He patented his process in 1856, and in the same year erected the first condensed milk factory in the world in the town of Wolcottville, Connecticut. The beginning was small, the process crude, and the product imperfect, and it was not until the strenuous years of the Civil war that the value and usefulness of condensed milk as a commodity became fully recognized. During the Civil war there was a great demand for this product, and from that time on, the industry increased with enormous rapidity. In the sixties the Anglo-Swiss Condensed Milk Company was organized in Switzerland, and the first factory of that company was built and operated under the direction of an American, George H. Page, in 1867. Both in this country and on the continent the condensed-milk industry grew rapidly. Every succeeding decade marked the organization of new companies and the erection of new factories, until today there are milk-condensing factories in nearly every civilized country within the dairy belt.

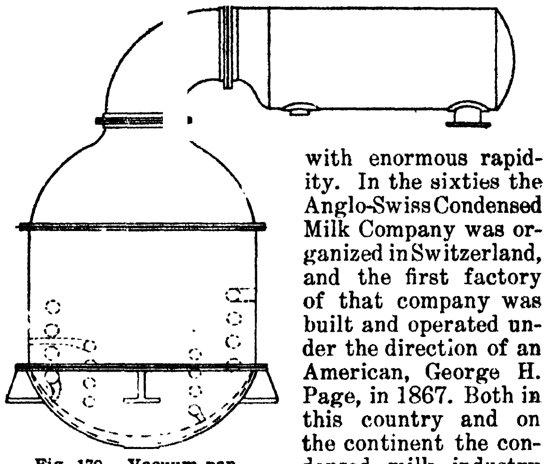

Fig. 179. Vacuum-pan.

According to the United States Census Report of 1905, there were in that year eighty-one condensed-milk factories in the United States, distributed over seventeen states, and receiving 712,000,000 pounds of fresh milk. The manufactured product amounted, in the aggregate, to 198,000,000 pounds of sweetened condensed milk, and 105,000,000 pounds of unsweetened condensed milk, at a total value of $20,060,000. The states leading in condensed-milk production are New York and Illinois, with a total output of 196,000,000 pounds, or nearly two-thirds of the entire output of condensed milk in this country.

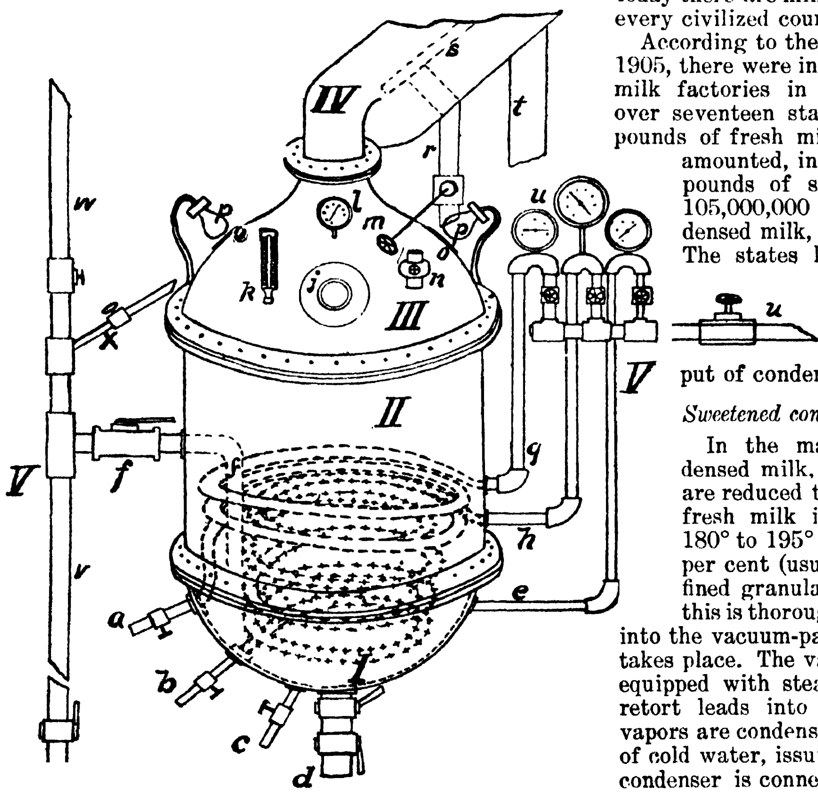

Fig. 180. The vacuum-pan, condenser and accessories. I. Jacket—*a*, steam outlet of large coil; *b*, steam outlet of small coil; *c*, steam outlet of jacket; *d*, outlet of finished condensed milk; *e*, steam inlet of jacket. II. Body—*f*, milk inlet; *g*, steam inlet of large coil; *h*, steam inlet of small coil. III. Dome—*j*, manhole cover with eyeglass; *k*, thermometer; *l*, vacuum gauge; *m*, valve for water inlet of condenser; *n*, blow-down valve; *o*, eyeglasses; *p*, electric lights. IV. Condenser—*r*, water-pipe leading to spray-pipe; *s*, spray-pipe; *t*, water outlet connecting vacuum-pump. V. Accessories—*u*, steam supply and gauges for jacket and coils; *v*, milk supply; *w*, water; *x*, steam.

Sweetened condensed milk.

In the manufacture of sweetened condensed milk, 2.75 to 3 parts of fresh milk are reduced to 1 part of condensed milk. The fresh milk is heated to a temperature of 180° to 195° Fahr. To the hot milk, 12 to 18 per cent (usually 16 per cent) of the best refined granulated cane-sugar is added. When this is thoroughly dissolved, the milk is drawn into the vacuum-pan, where the actual condensing takes place. The vacuum-pan is a retort (Fig. 179), equipped with steam jacket and steam coils. The retort leads into the condenser, where the hot vapors are condensed by means of a powerful spray of cold water, issuing from a perforated pipe. The condenser is connected with the vacuum-pump and the cold-water tank. (Fig. 180.) The milk is condensed under reduced pressure, which causes it to boil violently at a comparatively low temperature. The temperature in the vacuum-pan is regulated by the supply of steam to the jacket and coils, by the amount and temperature of the water spray in the condenser and by the capacity of the vacuum-pump. Although these conditions vary in the differ-

ent factories, experience has shown that about fifteen to twenty-five pounds of steam pressure in jacket and coils, a vacuum of twenty-five inches and a temperature in the retort of 130° Fahr., give the most satisfactory results. This ratio of steam pressure, temperature and vacuum make it possible to condense a batch of 15,000 pounds of milk in about two and one-half hours. Some processors do not add the cane-sugar until the condensation has been nearly completed. The milk is then swelled by super-heating with live steam, after which the sugar solution is added and the process finished.

Sweetened condensed milk, made from whole milk, and under normal conditions. has a specific gravity of 1.28 to 1.29. When the boiling milk in the pan approaches the desired degree of condensation, it is "struck." This term is applied to sampling and testing the sample for density.

The degree of condensation may be determined by various methods, such as weighing a definite quantity of the condensed milk on a sensitive scale, by the use of a resistance apparatus, or by means of a specially constructed hydrometer. Mechanical devices, such as the above, can be depended on when all the the conditions influencing the specific gravity of the liquid to be tested are definitely known, and when there is plenty of time for their manipulation. When the boiling milk in the retort is approaching the proper density, however, quick action is essential. One minute over- or under-condensing may cause the milk to be either too thick or too thin for the market and may necessitate the "re-running" of the entire batch with a new "run" of milk. Therefore, these instruments are practically worthless at the time they are most needed. There is not time carefully to measure and weigh out a sample of sweetened condensed milk, nor can the processor wait till the hydrometer has found its equilibrium in as viscous a fluid as sweetened condensed milk. Again, the density or specific gravity of the finished product depends on many and fluctuating conditions, such as the amount of heat applied towards the end of the process, the temperature of the sample drawn, and the per cent

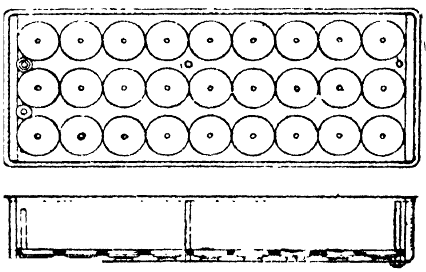

Fig. 181. Cooling vat.

of fat and of sugar that the condensed milk contains. For these reasons it is not difficult to understand why arbitrary mechanical instruments are not so satisfactory as the experienced eye and good judgment of the processor.

The finished condensed milk is drawn from the vacuum-pan into 40-quart cans, which are set in a cooling vat. (Fig. 181.) This vat is equipped with a series of revolving cog-wheels, on which the cans stand. Stationary paddles or stirrers, which scrape the sides of the revolving cans, are inserted. The cooling should be done slowly and the milk must be

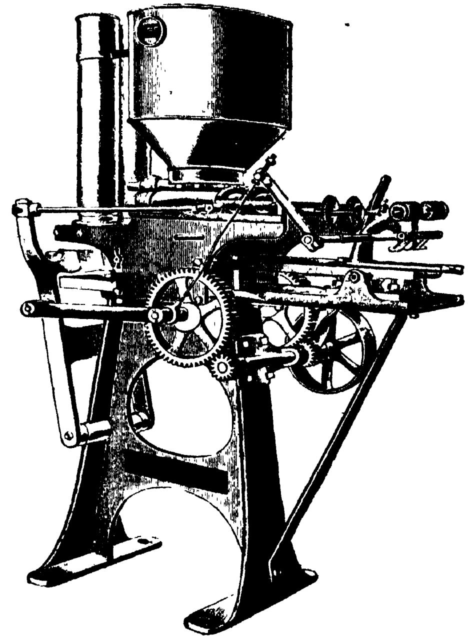

Fig. 182. The Stickney filler.

stirred constantly and thoroughly. Rapid and uneven chilling will cause the sugar in the milk to re-crystallize and thus make the product gritty or sandy. The sugar thus precipitated has a tendency to settle to the bottom after the condensed milk has been poured into tin cans and render it unfit for sale. (Fig. 182.)

The cooled condensed milk is poured either into barrels and sold in bulk, or into tin cans, hermetically sealed, labeled and sold in cases holding forty-eight cans.

Unsweetened condensed milk.

In the preparation of unsweetened condensed milk the fresh milk is condensed at the ratio of about 2.5 parts of fresh milk to one part of condensed milk. The process of heating and condensing is identical with that of sweetened condensed milk, but no sugar is added. When the milk has reached the proper density, specific gravity 1.06 to 1.08, which, in this case, can easily be determined by means of the hydrometer, the condensed milk is cooled and filled into tin cans, holding eight ounces to one gallon. These cans are then hermetically sealed. They are then put into iron trays and these are locked in the revolving framework of a sterilizer (Fig. 183), where they are subjected to a high temperature under steam pressure. In order to hasten the heating and to prevent the contents of the cans burning on the tin, they are kept constantly in motion. The heat applied varies

in different factories from 228° Fahr. to 236° Fahr., and the time of exposure from five to fifteen minutes. This sterilization has a threefold purpose, namely, to destroy all germ life, to give the contents of the cans a creamy texture and color, and so to change the physical condition of the condensed milk as to prevent the fat separating in transportation and in storage.

When the cans are taken from the sterilizer the condensed milk has the consistency of jelly or custard. In this condition it would not be salable. The next step, therefore, is to provide some means to break up this coagulum into a uniform, homogeneous mass resembling cream. For this purpose the cans are placed in the "shaker," a heavy iron box moving back and forth on an eccentric. Their exposure, for one minute, to violent agitation in the shaker brings about the desired results. From here the cans are transferred to the incubator room where they are allowed to remain for ten to thirty days, at a temperature of about 90° Fahr. This incubation is not an essential part of the process, but is merely a precautionary measure for the purpose of detecting leaky cans and those whose contents are not absolutely sterile, thus preventing defective milk leaving the factory. At the conclusion of this incubation the cans are labeled, packed in cases and shipped to their destination.

Plain condensed bulk milk.

This is an unsweetend, condensed milk which is not subjected to the sterilizing process and, therefore, is not sterile. It is generally more concentrated than the canned goods, three to five parts of fresh milk being condensed into one part of condensed milk. When the milk has reached its proper degree of concentration, the vacuum is broken and live steam is passed into the contents of the vacuum-pan for the purpose of swelling the milk. When the "superheating" has produced the proper "liver" (coagulum), the steam is turned off, the vacuum-pump started again and the process of condensing completed. The finished product is cooled and sold either in milk or cream bottles for direct consumption, or in forty-quart cans, to ice-cream establishments.

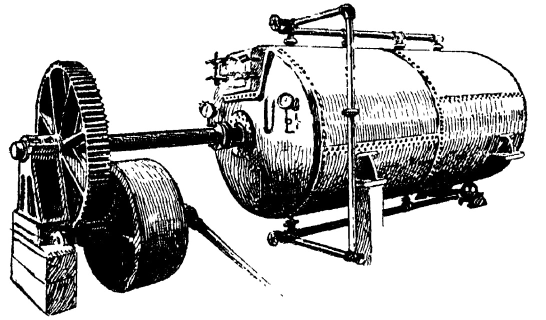

Fig. 183. The Baizley sterilizer.

Within recent years, a new process of manufacturing plain condensed bulk milk and milk-powders has been introduced and patented as the "Campbell Patent." In this process, the milk is condensed by forcing a current of hot air through it until the product has reached the desired degree of condensation. The points in its favor are that the initial cost of the necessary machinery is very small, an ordinary jacketed kettle taking the place of the expensive machinery required when milk is condensed under reduced pressure; and the milk is not heated to temperatures high enough to injure its digestibility. This process has so far been confined to the manufacture of unsweetened condensed bulk milk and milk-powders. [See page 194.]

Composition of condensed milk.

The composition of condensed milk depends on such factors as the composition of the fresh milk from which it is made, the degree of condensation and the percentage of cane-sugar added. As all of these factors vary in milk from different factories, and in milk from the same factory during different seasons of the year, no hard and fast rule can be given. The following figures merely represent the average composition of sweetened and unsweetened condensed milk as obtained from the results of a large number of analyses:

Sweetened Condensed Milk	Per cent
Water	26.5
Fat	9.0
Proteids	8.5
Milk-sugar	13.3
Ash	1.8
Cane-sugar	40.9
	100.0

Unsweetened Condensed Milk	
Water	71.0
Fat	8.4
Proteids	7.5
Milk-sugar	11.6
Ash	1.5
	100.0

The federal pure food law, which went into force in 1907, requires that condensed milk shall contain not less than 28 per cent of milk solids and that 27.5 per cent of these milk solids shall be fat.

Relation of the industry to dairying.

The presence of a condensed-milk factory, operated by a reputable concern, usually indicates a higher standard of sanitary dairying in the locality. There is, perhaps, no one dairy product the quality and usefulness of which depends so greatly on the quality of the fresh milk as does that of condensed milk. Though heated and preserved with cane-sugar, condensed milk is bound, sooner or later, to be affected by the many, and, in most cases, unfavorable conditions to which it is subjected in its transit from the manufacturer to the consumer, unless made from a high grade of fresh milk. Good, clean, sanitary milk is one of the essentials to the success of a condensory. As a matter of necessity, therefore, the condensory requires its patrons to

produce and transport their milk under sanitary conditions. The farmers are taught how to produce clean and wholesome milk, and how to take care of it. As these instructions are usually vigorously enforced, the condensory for its own protection is thus playing the rôle of an educational institution for the betterment of the dairy industry.

Like the city milk plant, the condensory uses up all there is in milk, and the dairyman can take back from the factory neither skimmed milk nor buttermilk. This is one of the serious disadvantages to which the condensory patron has to submit. Territories in which much stock is raised, therefore, are not suitable for the establishment of milk condensories, for there the farmer cannot afford to sell his skimmed milk. On the other hand, the condensory usually pays twenty to thirty cents more per one hundred pounds of milk than creameries and cheese-factories, a difference in price which, in localities not especially adapted for stock-raising, is ample compensation for the skimmed milk. Generally speaking, condensed-milk factories, operated by responsible parties, are a benefit to the farming community both financially and educationally.

The future of the industry.

That the condensed-milk industry has passed the experimental stage is amply demonstrated by the enormous rapidity with which the number of factories and the output of the old factories are increasing. That there is a place for the product in the future is strongly indicated by the fact that it has found its way into every country on the globe. Not only is its consumption increasing in localities and lands unable to produce fresh milk, in the mining camps, on the battle-fields, in the tropics, in the arctic region, on ocean liners and on men-of-war, but the demand for condensed milk in our home markets is growing with astonishing rapidity. This fact also suggests the possibility that the condensed-milk industry may help to solve the complex problem of supplying milk to our large cities in the future.

The fact that the condensed-milk industry is absorbing, today, a large and constantly increasing part of the fresh milk produced in our dairy states, causes this industry to be felt as an active competitor for the supply of fresh milk; it has become an important factor bearing on the milk-, butter- and cheese-market of the country, and promises to be a lasting and growing benefit to agriculture in many regions.

Literature.

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MILK-POWDER

By *Geo. W. Cavanaugh*

Milk-powder is the dry solids of milk in the form of a powder. Either whole milk or milk wholly or partly skimmed may be used in its preparation. The milk must be sweet and produced under sanitary conditions to yield a powder of good quality.

A milk-powder should fulfil these conditions: (1) It should contain not to exceed 2.5 per cent of moisture. This small amount precludes the action of bacteria. (2) The milk-fat must be in the original globular form, otherwise the powder will not mix with water to a true emulsion. (3) The milk albumen must not be coagulated. When the milk albumem is coagulated, the solubility of the powder may be reduced so that part of it will settle out on standing. There will also be a taste that is characteristic of boiled milk.

History.

The first patent recorded for producing dry milk was granted to a Mr. Newton by the British Patent Office in 1835. Other patents were recorded from time to time, but there is no record of the processes described in them being commercially successful until the years 1899-1900. Since the latter date, five or six factories in New York and New Jersey have been producing considerable quantities of powdered milk by various processes. Outside the patent records, there is yet no literature on the subject.

The composition of milk-powder.

Whole milk has an average composition as follows: Water, 87.1 per cent; fat, 3.9 per cent; casein, 2.5 per cent; albumen, .7 per cent; sugar, 5.1 per cent; ash, .7 per cent. One hundred pounds of whole milk yields, therefore, about thirteen pounds of solids and skimmed milk about nine pounds. The partly skimmed milk will yield an amount of solids according to the degree to which it has been skimmed. Powdered milk made from whole milk has a composition approximately as follows: Moisture, 2 per cent; fat, 28.5 per cent; casein, 20 per cent; albumen, 5.4 per cent; milk-sugar, 39.3 per cent; ash, 5.8 per cent. Milk-powder made from half-skimmed milk has a composition approximately as follows: Moisture, 2 per cent; fat, 17 per cent; casein, 23.6 per cent; albumen, 6.5 per cent; milk-sugar, 43.7 per cent; ash, 7.2 per cent. Skimmed-milk-powder may have the composition: Moisture, 2 per cent; fat, 17 per cent; casein, 28 per cent; albumen, 7.4 per cent; milk-sugar, 53.6 per cent; ash, 8 per cent.

The processes.

As a part of the solids of milk are in solution and a part in the form of an emulsion, the water may not be removed by any process of straining or filtering, but must be removed by evaporation. The resulting solids should be miscible with water to yield a liquid milk in which the several constituents have the same physical and chemical properties that they possess in ordinary milk. The processes for the removal of the water by evaporation, and

which accomplish the above desirable results, wholly or in part, may be grouped as follows:

(1) Boiling the milk under reduced pressure in a vacuum and stirring until the water is evaporated. The dry mass is then ground to a powder.

(2) Exposing the milk in a thin layer on the surface of a revolving cylinder that is heated by steam. A knife removes the dried layer, which is then ground to a powder.

(3) Exposing the milk in a thin layer on the surface of a revolving cylinder that is heated either by steam or hot water, the cylinder being enclosed in a vacuum chamber. This makes it possible to effect the evaporation at a lower temperature.

(4) Passing a current of warm air upwards through the milk until the milk thickens, and then evaporating the remainder of the water by exposure to heated air. This is followed by grinding.

(5) Exposing the milk in the form of a spray to a current of heated, dry air, in an evaporating chamber. This process is based on the fact that an atomized liquid in the form of a mist offers the maximum surface for the evaporation of its water. The evaporation is so nearly instantaneous that the milk solids are in the form of a dry powder when they fall. No grinding or pulverizing is necessary.

One cause of the relatively slow development of successful processes is found in the difficulties encountered in the complete removal of the water from milk after the material becomes thickened by evaporation. By continuing the ordinary process of evaporation, there is a necessary concentration of each constituent of the milk. All milk contains small quantities of acids even when perfectly fresh. On concentration these acids reach a degree which, together with the heat employed, tends to coagulate the milk albumen and to curdle the casein. Thus, while all the water might be removed by continuing the process of evaporation, its removal would be accompanied by a decrease in the solubility of the resulting powder. Certain media may be used to neutralize the acids of milk.

Uses and advantages.

Milk-powder is particularly adapted for use in baking, for which it may be used either by mixing directly with the flour or by reconstituting and then using as ordinary milk. When the powder is mixed dry with the flour, the mass may then be moistened with water, and the same result secured as by the use of liquid milk.

In the preparation of some kinds of confectionery, as chocolate, the use of whole-milk-powder is very advantageous. The water in ordinary milk or cream sometimes causes an uneven distribution of the fat or oil of the chocolate that impairs the color. This is entirely avoided by the use of milk in the dry form. In the preparation of ice-cream, powdered milk may serve not only as the basis of the milk or cream that is used, but also as a thickener in the place of gelatine.

A comparison with the ordinary sweetened condensed milk will show the relative advantages of powdered milk when transportation and economy of storage are concerned:

Condensed milk	Per cent	Milk-powder	Per cent
Moisture	25	Moisture	2½
Milk solids	35	Milk solids	97½
Cane-sugar	40		

The transportation of milk in the form of powder avoids the usual refrigeration and hence may be by freight. The manufacture of powdered milk will undoubtedly have an important bearing on the whole dairy industry, making possible the transportation of fresh sweet milk from places heretofore inaccessible because of distance.

MANUFACTURE OF ICE-CREAM AND OTHER FROZEN PRODUCTS

By *H. E. Van Norman*

The term ice-cream is applied to any frozen mixture resembling frozen cream and based on milk products. Literally speaking, it is cream sweetened, flavored and frozen. Sometimes it is a combination of cream with milk, skimmed milk or condensed milk, starch, eggs or gelatin, sweetened with sugar, syrup or glucose, and flavored with fruit juices, extracts, fresh or canned fruits, fruit syrups, nuts, liquors, macaroons, bread-crumbs.

When large quantities of cream are made for a moderate-priced trade, gelatin is often used to make the cream "stand up" or retain its shape when shipped or held for several days. When cream is low in butter-fat, certain fillers are added to give body to the product, such as rice flour, cornstarch, sago, arrowroot and gelatin. Condensed milk and condensed skimmed milk are used to give body and smoothness when cream is not rich.

Owing to the confusion of terms and standards of quality, there is a growing disposition to conform in local practice to the standards promulgated by the authority of Congress for interstate commerce, which recognize as ice-cream only that product made from a standard cream (containing 18 per cent of fat), sweetened and flavored.

Kinds of frozen dishes.

Mousse is rich cream beaten stiff, sweetened, flavored, placed in a mold and frozen without agitation. It must remain about three hours in a freezing mixture of equal parts of salt and ice. *Water-ice* is fruit juice sweetened, diluted with water and frozen. This requires a colder freezing mixture than cream. *Sherbet* is water-ice to which has been added gelatin, or beaten whites of eggs. It may be a combination of the juice of several fruits. *Frappé* is water-ice frozen only to the consistency of mush. *Punch* is water-ice to which have been added liquors and spice. *Neapolitan* is usually a combination of three different flavored ice-creams in a brick. The term is sometimes applied to a cooked cream containing eggs.

Ice-cream. –There are many kinds of ice-cream and many names for them. Generally speaking, ice-creams may be divided into plain creams and cooked creams. The plain product is usually called Philadelphia cream. It is a raw cream sweetened, flavored and frozen. In commercial establishments

in which large quantities of ice-cream are made, the cream usually is not cooked except as pasteurized cream is used in place of raw cream. On the other hand, in catering establishments, where small lots of fancy creams are made, and in the family kitchen, the ice-cream mixture is frequently cooked, or at least heated to the boiling point. This is desirable with all formulas in which eggs are used. The proportion of the foundation materials may be varied to suit the requirements of each maker. This is especially true of the cream. The cook-books give an infinite variety of recipes, many of which differ only in the richness of the cream or the proportion of sugar, eggs, fruit or other flavoring material.

Ice-cream-making.

The cream.—The cream for an excellent quality of ice-cream should contain 20 to 25 per cent of butter-fat. Cream raised by allowing the milk to stand twenty-four hours, or from the centrifugal separator, set so that the cream is not more than one-sixth of the volume or weight of the milk to begin with, usually will have about this percentage of fat in it. Double cream should contain 35 to 45 per cent of butter-fat. Too rich cream may be reduced to suit the taste by the use of skimmed milk or whole milk. Some commercial makers reduce it as low as 10 per cent of fat.

The cream should be free from taints and all undesirable flavors, as freezing does not drive off or materially disguise them. In commercial work, stable taints and "cowy" odor or flavor should be guarded against. The cream should not contain over .3 per cent of acid and, preferably, only .2 per cent.

If cream containing too much acid, i. e., slightly sour, must be used for ice-cream-making, its acidity may be reduced by the use of a little bicarbonate of soda (common baking-soda). If more soda is used than is necessary to neutralize the acid, it will give the cream a bitter taste.

Pasteurized cream may be used in part or entirely. It is important that it should be thoroughly cooled, and it is better if it has been held at a temperature below 45° for one to three days after pasteurizing, as this increases the apparent body and the over-run of the ice-cream.

Condensed milk.—The commercial product usually sold for use in ice-cream manufacture may be a condensed skimmed milk or whole milk. Its use adds to the body and smoothness of a cream not rich in butter-fat, due to the milk solids other than fat in the condensed milk. It may replace one-fifth of the cream.

Sugar.—The sugar may be added to the cream and should be allowed time to dissolve thoroughly before the cream is put into the freezing-can. It may also be made into a syrup and added in this form, although the least water that will answer the purpose in making the syrup, the better. If any milk is to be used in the mixture, it may be measured out and the sugar added to it, as the sugar will dissolve more rapidly in the milk than in the richer cream. Gentle stirring will hasten the dissolving. When preserved fruits, fruit-juices and syrups are used, less sugar will be required.

Flavoring.—Flavors may be crushed fresh or canned fruits, fruit juices or syrups, extracts or nuts, browned bread-crumbs, macaroons, grape-nuts, and the like. The flavoring material may be added to the mixture before freezing begins, or it may be added when the cream is frozen to the consistency of mush. The latter practice is more desirable in the case of alcoholic extracts, as these are volatile; also with fruits that are fleshy, and which it is desirable should not be frozen too hard, or when sour fruits are used. With sour fruits, such as raspberries, strawberries, and the like, part of the sugar should be mixed with the fruit. With canned peaches the addition of lemon-juice is recommended, one lemon for each gallon of the peaches. The vanilla-bean may be ground and mixed with powdered sugar and used for flavoring, the fine specks of the bean not being objectionable when it is understood what they are; or an alcoholic extract may be used. Since the cold cream lessens the acuteness of the sense of taste, the unfrozen mixture must be flavored more highly than would be necessary if it were to be eaten unfrozen.

Salt for freezing.—This should be coarse rock salt. Ordinary fine or stock salt may be used, although it is not very satisfactory.

Ice.—The ice should be crushed. It may be crushed in small amounts in a bag with a wooden mallet, or in a box with a spiked ice-crusher (Fig. 184). The finer the ice the more rapidly it melts. The colder the freezing mixture the quicker the freezing will take place. For small lots of cream, snow can be used, although it is not desirable.

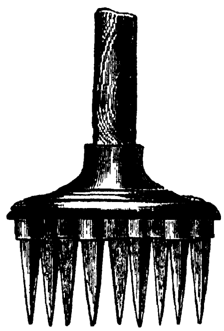

Fig. 184.
Spiked ice crusher.

Freezing.—The freezing is brought about by the melting of the ice by the salt. The greater the proportion of salt the colder the freezing mixture and the more rapidly the cream will freeze. If this occurs too rapidly, the cream will be coarse and granular. If it is too slow, the fat of the cream may be churned and appear as small particles of butter or the cream may be greasy.

For large freezers, one part of salt to each eight or ten parts of ice is satisfactory; for small freezers, the proportion may be increased to one of salt to four or five of ice. For water-ice, mousse, and creams with syrups or liquors, the proportion of ice and salt may have to be increased to one to one or two, and the ice made fine. The proportion of ice and salt should be such as to freeze the mixture in twelve to fifteen minutes. If the agitation is continued too long, the cream will be granular and coarse and the swell or over-run will be less.

The ice and salt may be placed in the freezer in alternate layers. With a large freezer, it is preferable to mix them first in a box or on the floor.

When the mixture is ready for the freezer, if it is not thoroughly chilled, the freezer should be put in motion slowly or rotated intermittently in order that the mixture may be chilled thoroughly before starting at full speed, thus preventing the churning of the fat particles before the cream becomes chilled. The cream should not be allowed to stand still in the freezing mixture, as cream freezing to the sides of the can scrapes off and makes lumps in the finished product. The richer the cream the more quickly it will freeze. The agitation should be stopped when the cream rolls up on the stirrer, has a consistency like thick mush, and is no longer shiney and watery in appearance. Because of the viscous nature of cream and the agitation of the stirrer, and other factors, more or less air is incorporated in the cream causing it to swell or over-run; the can, therefore, should not be filled more than two-thirds full of the mixture. In factory work, five and one-half gallons of mixture should swell and make ten gallons of frozen cream.

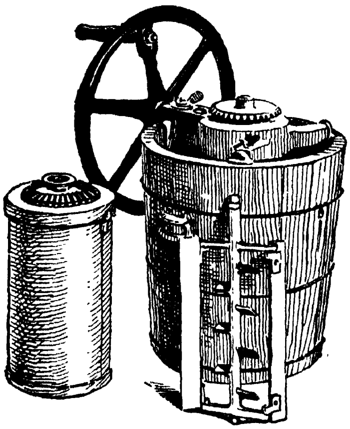

Fig. 185. A hand freezer. Made in 1- to 20-quart sizes.

The freezer.—A good freezer should be so arranged that the can and dasher revolve in opposite directions. Figs. 185–187 show types of hand and power machines.

Speed of freezing.—The speed of the factory freezer should be such that the can will make 135 to 160 revolutions per minute. The ordinary hand freezer should be run at 80 to 100 revolutions of the crank per minute.

Ripening.—As soon as the cream has sufficiently frozen, the stirrer should be removed, the cover replaced, ice and salt added, if necessary, and the ice-cream allowed to stand in order that it may become hardened throughout. The smoothness of the cream is usually improved by this ripening period, which consumes one to twenty-four hours. In commercial work, the ice-cream is sometimes held for two or three days.

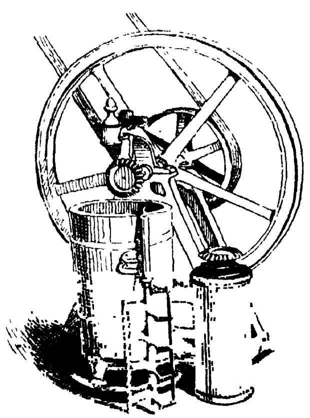

Fig. 186. A factory ice-cream freezer. Made in 18- to 40-quart sizes.

Fancy creams.

In small lots for home use, fancy creams may be made directly from formula as desired. For bricks and fancy forms in molds, the cream should not be frozen too hard. A little gelatin is often used to make the forms retain their shape when served. The bricks and molds should be packed in ice and salt until hard. One to three hours is required, depending on the shape and size of the mold. A larger proportion of salt should be used and the brine should be allowed to drain out of the packer if the molds are not tight. Molds may be made tight by covering the cracks with butter. To remove the cream from the mold, dip the mold in cold water, never in hot.

In commercial work it is not uncommon to use vanilla ice-cream as a basis for small orders of

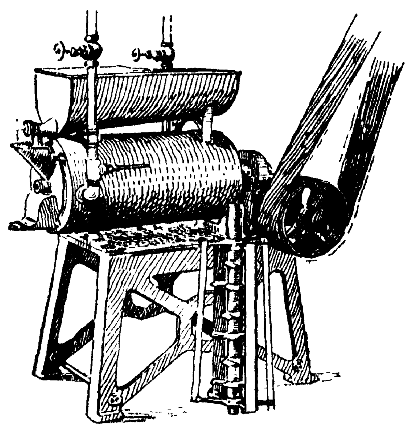

Fig. 187. A brine freezer, 40 quarts capacity.

special flavors and fruits, by stirring them into the vanilla cream and placing it in bricks or other molds.

Formula.—For this purpose, 1 cup=½ lb.; 1 pt.=1 lb.; 8 lbs.=1 gal.

For 1 gal ice-cream		For 10 gals. ice-cream
2½ qts.	Cream	44 lbs.
1½ cups	Sugar	7½ lbs.

Flavor.—The amount of flavor must be determined by trial. The following suggestions may help the beginner:

1–2 teaspoonsful	Extracts	2 4 ozs.
1 teaspoonful	Chocolate	7 ozs
½–1 pt.	Crushed fruits	5½ lbs.

If the cream is not rich, the yolks of two to four eggs may be added for each gallon of cream. When the eggs are used it improves the product to heat the cream and eggs nearly to the boiling-point but not allow them to boil. The amount of crushed fruits may be very materially increased if desired.

This formula is for a good commercial or family ice-cream. A great variety of formulas will be found in the cook-books commonly available.

Brine freezing.

In factory work the brine, cooled by artificial refrigeration or made by the use of salt and ice, is used in machines arranged for this purpose. A temperature of 11 to 13° Fahr. is usually satisfactory. The use of refrigerating machines to cool brine for freezing and to hold ice-cream in storage is growing rapidly, because of its great commercial economy and saving of labor.

Ice-cream poisoning.

The poisoning which is occasioned by eating ice-cream is due to ptomaines produced by bacteria that are associated with unclean utensils at low temperatures. Because milk sours slowly at low temperatures, some makers have been careless in the matter of cleansing the utensils used for storing ice-cream, and this has resulted in the formation of products that have caused sickness and occasionally death.

Uses of ice-cream

Ice-cream finds large use as a dessert at the tables in hotels, restaurants and homes, and of late has found increasing use at soda-fountains and in ice-cream parlors. Most establishments that serve it at the soda-fountain are provided with paper or other inexpensive, non-returnable packages, and have trade that demands a supply of ice-cream to be consumed immediately, thus not requiring any packing. They make their own ice-cream or buy it from a large manufacturer, often securing it from a considerable distance. The economy of manufacture in large establishments has enabled the latter to ship, at a profit, immense quantities to the outlying towns.

The volume of the trade has demanded, first, the brine freezer as an improvement over the use of ice and salt, and now, the continuous freezer. The latter is fed with brine and cooled by artificial refrigeration. It receives a continuous supply of the cream mixture at one end of the freezer and delivers at the other the frozen product at the rate of sixty to one hundred and fifty gallons per hour.

Aside from the shock incident to eating large quantities of ice-cream quickly, and especially after a heavy meal, it is a most healthful food and dessert or luxury, for it would seem that it should be classed with food since it is rich in the nourishing fat and sugar. In sickness, especially in fever cases, the physician finds it useful because of its cooling effect. The ices and punches are largely used as appetizers at meals served in courses, for which they are well suited, being acid and lacking the butter-fat of the ice-cream.

Cost of production.

In the eastern and thickly populated states, many ice-cream factories turn to the creameries for their cream. They can pay for the cream a price considerably in advance of what it is worth for butter. When ice-cream of medium quality sells for 80 cents per gallon, the ice-cream-maker will pay 60 cents per gallon for the cream, containing 18 to 20 per cent of butter-fat. This will make about 41½ cents per pound for the butter-fat in an 18 per cent cream, or 37½ cents in a 20 per cent cream, as compared with 20 to 25 cents, the price that the butter-maker can usually afford to pay for butter-fat during the summer months. A gallon of cream costing 60 cents may make, with the sugar and flavoring-mixtures, 1.6 gallons of ice-cream, and sometimes even more, to sell at 80 cents per gallon, netting $1.28, for the butter-fat, for which the butter-maker pays about 40 cents. It must not be forgotten that the uncertainty of the weather and the irregular demand for the product, the difficulty of disposing of the product in cold weather, the losses from insufficient packing, the cost of ice for holding from day to day, the loss of packers and tubs through failures to return, especially if shipped to distant points, the labor of delivering to patrons and going after the packers when empty, all make a large total expense.

Literature.

The only literature on ice-cream-making available is found in the cook-books and one small book by Mal. Miller, entitled "Thirty-six Years an Ice-Cream-Maker," which gives many useful hints on practice, together with formulas, but little on principles. A few good articles have appeared in "The Ice-Cream Trade Journal," "The New York Produce Review," other creamery journals and the confectioners' journals. There are as yet no experiment station bulletins on the subject.

BUTTER-MAKING

By *Edwin H. Webster*

Butter is defined as "the clean, non-rancid product made by gathering in any way fat from fresh or ripened milk or cream, into a mass which also contains a small quantity of other milk constituents, with or without salt," and "may also contain added coloring-matter." Butter is usually made from cream, "which is that part of milk, rich in milk-fat, which rises to the surface of milk on standing or is separated by centrifugal force."

The importance of the butter industry is indicated by the report of the last census (1900), when 1,071,745,127 pounds were reported from farms and 420,126,546 pounds from creameries and factories in the United States. The Canada Yearbook, for 1905, reports 105,343,076 pounds of home-made butter for the year 1901.

In this article we will consider first, and at length, the making of butter on the farm, and second, briefly, the factory methods. Much that is said in the first case applies in the second.

I. Butter-making on the Farm

Creaming the milk.

There are two general methods in practice for creaming the milk. One is to place the milk in shallow pans or deep cans, and allow the cream to rise by gravity. The other is the use of the centrif-

ugal separator. (Fig. 188.) Creaming by the gravity method is best accomplished by the deep-setting system, the cans being submerged in water.

Advantages of mechanical separation.—Under the best usage the gravity method may leave one-eighth to one-fourth of the fat in the skimmed milk, while the mechanical or centrifugal separator removes practically all of the fat, leaving the skimmed milk fresh and sweet, and in a superior condition for feeding young stock. There are numerous kinds of mechanical separators on the market, but they differ in details of construction rather than in the principles on which they work. The dairyman should thoroughly understand these principles.

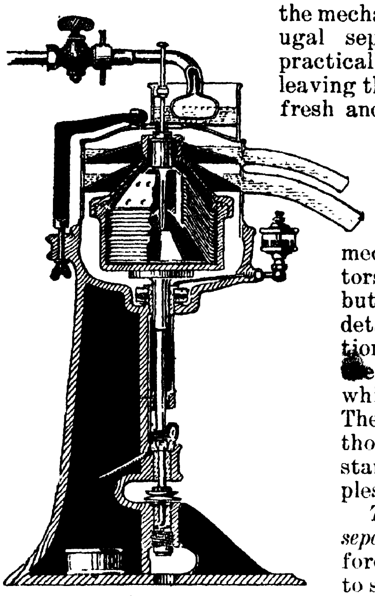

Fig. 188.
Sectional view of a modern power centrifugal separator.

The principles of separation. — The force that is used to separate the milk is known as centrifugal force. This force may be described as the pull that is felt when a weight attached to a string is whirled about the hand. It is the pull outward, and the faster the weight is whirled, the stronger the pull becomes. In the old system of creaming, the separation is caused by the action of gravity. The fat globules, being lighter than the other parts of the milk, are forced to the top; that is, gravity acts stronger or pulls harder on the heavier parts than it does on the lighter, and the milk is gradually arranged in layers, the lighter part at the top, and the heavier part at the bottom. The force acting in the separator has precisely the same action on the milk, but acts outward from the center of the bowl the same as gravity acts downward from the surface, only many thousand times stronger, accomplishing in a few moments and far more completely what it takes gravity several hours to do.

As the milk goes into the bowl it is at once thrown to the outermost parts and fills the bowl completely until an opening is reached where it will flow out again. The surface of the milk is on a line parallel with the center, or axis, of the bowl, and is exactly in line with the cream outlet. A cross section through the bowl from this surface to the outside presents much the same appearance as would a pan of milk after the cream has raised by gravity. The cream is on the surface, which might be called the top, and the heavier parts of the milk at the point farthest from the center, which would represent the bottom.

There are a number of things to be observed which influence the separation. The difference in length of time required to separate cream by gravity and by centrifugal force shows plainly that the time varies with the amount of force applied. The shorter the time, the greater the force must be. Skimmed milk from the separator contains less fat than that secured by the gravity system, showing that the greater force causes more perfect separation.

From the above statements the following conclusions regarding the use of the separator may be drawn: (1) If the amount of milk that passes through the separator in a given time is a fixed quantity, any increase in the speed of the machine will tend to cause closer skimming because of the greater force exerted; (2) if the amount of milk that passes through in a given time is increased and the speed remains the same, the skimming will not be so perfect, for the centrifugal force is not exerted on the milk for so long a time. It is evident, therefore, that the closeness of skimming is the result of two factors,—time and force. If either of these is decreased, the result will be poorer work. The temperature and character of the milk are also influencing factors.

Common errors in operating separators. — Two errors are made in operating separators because of ignorance of the facts just stated. The first consists in allowing too much milk to pass through the machine. As there is a limit to the speed at which the machine can be run safely, it is not good practice to try to overcome the error referred to by increasing the speed beyond the safe point. The feed outlet is usually fixed so that too much milk will not run through, but cases have been observed in which operators, anxious to shorten the time of separation, have enlarged the opening, allowing too much milk to pass. This error is not so common as the second, which is to allow the speed of the machine to become too slow. The slow speed does not generate enough force to skim properly, and the result is loss of butter-fat in the skimmed milk. The number of revolutions per minute required by a machine is usually indicated on the machine or in the instruction book belonging to it, and this should be strictly followed.

Best temperature of milk for separating.—All liquids flow more readily when warm than when cold. Cream is one of the products of separation. It has to flow from the machine through a small opening or outlet. The warmer it is the more readily it will flow. If the flow of the cream is checked, more milk will be forced out of the skimmed milk outlet, and if the obstruction to the flow becomes too great, butter-fat will go out with the skimmed milk, because it can not move fast enough through the cream outlet. For this reason, the nearer the temperature of the milk approaches the animal heat the better will be the separation.

Summary of points to be observed.—To summarize, the points in the operation of a separator, given in their order of importance as bearing on the quality of the work, are as follows:

(1) The speed of the separator must be uniform

and up to the standard required by the makers of that particular machine.

(2) The temperature of the milk should be such as will make it flow readily; the warmer it is the more perfect will be the separation.

(3) The amount of milk that is run through the machine should remain constant, and should not be increased over the amount intended for the machine.

(4) The machine should be set on a solid base or foundation, so that there will be no jar or shaking about as it is turned, such as would tend to interfere with the even flow of the milk through the bowl and thus to destroy its efficiency in skimming.

(5) The separator must be kept thoroughly and scrupulously clean, particular care being taken that none of the tubes through which the milk flows become obstructed in any way.

(6) The test of the cream can be readily changed by changing either the cream outlet or the skimmed milk outlet.

In the mechanical operation of a machine, none but the best oil should be used, and this should not be allowed to gum on the bearings. It is good practice to flush the bearings with kerosene occasionally by making a run with kerosene in the oil cups. This will serve to cut out any gum or dust that has accumulated in the bearings and will make the machine run much freer and easier, thus greatly increasing the length of time that it will last and do perfect work.

Ripening the cream.

Changes in milk.—A study of bacteria (p. 187), their habits of growth, food on which they live, kind of medium in which they can develop, and the temperature most favorable to their growth, reveals the necessity for observing cleanliness in all dairy utensils and for keeping the milk cold. Bacterial life is in evidence everywhere, and only awaits the proper food, moisture and warmth to cause the bacteria to multiply very rapidly. Just as a grain of corn grows when given proper moisture and warmth, so the germ life that finds its way into milk utilizes the food and warmth found there to grow and multiply, causing decomposition. When milk is kept free from bacteria it will not spoil. When it is heated to a high temperature, most of the bacterial life is destroyed. This prolongs the life of the milk very materially unless additional bacteria find their way into it and it is allowed to stand at temperatures favorable to growth.

Fortunately, many species of bacteria known to exist in milk are not harmful. Many are beneficial in that they develop flavors desirable in good butter. From this it appears that the knowledge of methods necessary to check or destroy bacterial development is but a part of the butter-maker's art. He must know how to promote the growth of the desirable kinds. Up to the point of ripening the cream the whole process is one of retarding the development of bacteria by cleanly methods and the use of cooling devices. When the ripening process begins, the growth of favorable kinds is encouraged.

Cream direct from the separator should be perfectly sweet, and if cooled properly will remain so for a number of hours. In fact, it can be preserved four or five days if kept at a temperature below 50° Fahr. It might be churned in this condition, and a quality of butter made that is excellent, but, practically speaking, the great bulk of butter is churned from sour cream. Fresh sweet-cream butter is somewhat flat and insipid, but improves with age, up to a certain point, if made from pure, clean cream. A tubular type of cooler for factory use is shown in Fig. 189.

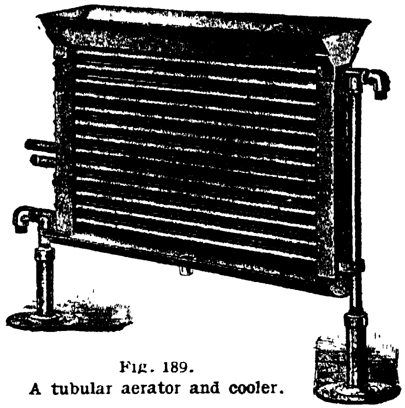

Fig. 189.
A tubular aerator and cooler.

The starter and its use.—The dairyman may ask, if it is necessary to sour the cream, why take so much pains to keep it sweet. The trouble with ordinary souring is that it may not be of the desirable kind. Cream must be handled in such a way that desirable flavors will be developed and the undesirable ones kept in check. This can be done only by starting with a perfectly sweet cream and controlling the souring process. This control is secured by introducing into the cream what is known as a "starter." A starter is nothing more nor less than nicely soured milk either whole or skimmed. It will contain those kinds of bacteria that will develop the good flavors wanted, and not those that cause putrefaction, gassy fermentations, and similar undesirable changes. As has already been stated, the greater number of bacteria present are the favorable kinds, and when milk is handled in a cleanly manner practically all that find entrance are of these kinds. To secure a starter containing desirable bacteria, the dairyman has simply to set away some skimmed milk as it comes from the separator and await developments. If the milk is kept at a temperature between 70° and 80° Fahr., it should sour within twenty-four hours and form a solid curd. A test of this curd shows whether or not the dairyman has kept his milk clean. If the taste is found pleasant and mildly acid, and the curd readily breaks up when poured from one vessel to another, becoming creamy, and showing no hard lumps that will not break down, he has a good starter. On the other hand, if the curd is stringy, or will not break with a square, sharp cleavage, but seems to be granular, or if a clear whey is formed on the surface, it shows that bacteria of a harmful species are present. The formation of this curd is caused by the development of acid in the milk. If the souring continues too long and too much acid is formed, the starter becomes sharp and unfit for use. After a certain amount of acid is

formed its further development is checked, but this does not occur until the milk is too sour for a good starter.

The starter is at its best just as the curd becomes firm, and the dairyman should plan to have this occur at the time he wants it to put into the cream. A glass jar is the best vessel in which to make a starter. The glass surface, being smooth, is easily cleaned, and the butter-maker can see what action is taking place while the milk is souring. If there are gas-producing bacteria in the milk, little bubbles of gas will form in the bottom and along the sides of the jar. If these are formed the starter should not be used, as gas fermentations always indicate impurity.

The amount of starter that should be used in the cream will vary under different conditions. Ordinarily, if one is churning every day, about one to one and one-half gallons of starter in ten gallons of cream is the right proportion. If it is necessary to hurry the process of souring, more starter may be used, and vice versa. The temperature at which the cream is set will influence the amount of starter to be used. If the cream is cooled to about 60° Fahr., it will require more starter than if it is set at 70° Fahr. Unless the dairyman has means of controlling the temperatures quickly, either by very cold water or by means of ice, it is best to have the cream as cold as well-water will make it (which will usually be 60° Fahr.), when the starter is added. If the cream is to be held for the next eighteen or twenty hours at this temperature, the amount of starter necessary to add can be determined after two or three trials. Attempt should be made to add just enough starter to have the cream soured properly at churning time. No absolute rule can be depended on for this work. The dairyman must use his intelligence and decrease or increase the amount of starter and raise or lower the temperature of the cream in such a way that it will be ripened and ready for churning at the proper time.

If the cream is not to be churned every day, but must be held two to four days before enough is secured for a churning, either of two practices may be followed: a very small amount of starter may be added to the first batch of cream, which will cause the gradual development of the acidity, or the cream may be held sweet for two to four milkings, and then the starter added in a little larger quantity, with a view to having the ripening completed about twelve to eighteen hours after the last lot of cream is added. Here again the dairyman must use his judgment and experiment until he finds just the right quantities and the right time to add the starter.

Whole milk can be used for making a starter, as well as skimmed milk, but it is usually considered best to use the latter. The surface of the starter should be skimmed off for a half inch or so in depth and thrown away. This is necessary because in opening the jar for examination or for any purpose, dust may have entered and formed colonies of undesirable bacteria which will be growing on the surface, but have not reached any depth in the milk. When whole milk is used, this skimming is not desirable because of the loss of butter-fat that would have risen to the surface.

It is sometimes necessary, in order to secure a good starter, to save a number of samples of milk and select the best from the lot. When an exceptionally good starter is secured, it can be propagated from day to day by adding a little of it to a quantity of sweet skimmed milk, enough milk being used to make the necessary amount of starter for the cream to be churned. This controls the souring of the milk just the same as the addition of starter to the cream controls the souring of the cream. When one is churning every day, this is a very good method for carrying forward the starter. It may be used when but two or three churnings a week are made just as satisfactorily, discarding the lots on the days when there are no churnings.

Under factory conditions, when mixed milk from a number of herds is used, it is always necessary to heat the milk intended for the starter to near the boiling point to destroy the bacteria that it may contain, and then renew the germ life in it by adding a part of a well-ripened starter; but under farm conditions there should be no necessity for this. The milk should be so clean and so pure that the only decomposition which takes place would be that of souring, and it will usually be found that this souring gives the pleasant taste to the milk that is desirable in the butter.

When an attempt is made to ripen the cream without the addition of a starter the results are not usually so good. An example of what takes place in cream can be readily seen after one has some experience in making starters. Very often one sample of milk will not develop the desirable flavors, but will become entirely unfit to use in the cream as a starter, while another sample, perhaps taken from the same day's milking, will sour with a fine flavor. The cream contains the bacteria that developed in both of these starters; each kind has equal chance to develop, unless a large quantity of the right kind is introduced. These would overcome the undesirable kind present and thus control the changes which take place. This is the purpose of the starter.

When cream from several separations is collected, the churning should not be made for a number of hours after the addition of the last lot of cream. Unless this time is given the fresh cream added will not have soured, although it will be mixed throughout the mass of sour cream, and if churned in this condition much butter-fat will be lost in the buttermilk. Time must be given for complete and thorough blending of the various lots so that they are practically one, the acid being developed in all alike. This may be done very nicely by taking the previous night's separation as the last and churning the next day, thus giving ample time for the proper ripening of the last cream added.

During the last few hours of ripening there should be taken into consideration the temperature at which the cream must be churned. When it is completely ripe or has reached that point at which

the flavor is fine and the aroma good, it should be quickly brought to the temperature necessary for churning, if not already at that temperature. If it has to be lowered several degrees, it should stand at the churning temperature for a period of three

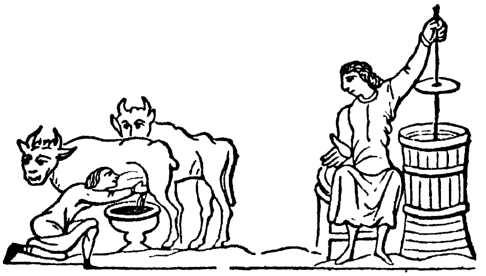

Fig. 190. Butter-making as represented in the twelfth century in England.

or four hours before churning. This becomes necessary because the butter-fat is a poor conductor of heat and takes longer to change in temperature than the milk serum.

During the process of ripening, the cream should be stirred occasionally to obtain best results. Just what is the result of stirring or why it is necessary, is not entirely understood, but it is known that cream stirred frequently ripens with a more uniform and finer flavor than cream ripened without stirring.

The acid test.—The only standard that has been applied in measuring the ripening of cream is the determination of the acid present. The acid test, as it is called, is a fair index of the quality and stage of ripeness. It is true, however, that two lots of cream may have exactly the same amount of acid and one of them be good and the other bad; so, after all, the acid test is not infallible. There is no step in the whole process of making butter when the judgment of the maker is so much needed as in ripening the cream. He must cultivate his taste for the desirable flavors and must know when the point is reached at which further ripening must be checked. Neither the butter-maker who depends entirely on the sense of taste and smell, nor the one who depends entirely on the acid test will get the best results.

Methods of learning to taste and smell, or judgment in their use, can not be written out. The ability must be developed through experience. The amount of acid present, however, is capable of exact determination by the test. [See page 180.]

Coloring the butter.—If the butter is to be colored artificially, this should be done after the cream is placed in the churn. Only a harmless color should be used. The amount to be used will depend on the season of the year and the demand of the trade.

The churn and churning.

No other utensil in connection with dairying has received so much attention from inventors as the churn. Most of the efforts along this line have been to get a churn that would save time. The thirty to forty minutes spent in churning has seemed a prodigious waste to the ambitious inventor. The one-minute churn has been the goal. There have been more patents issued by the patent office on churns than on any other one device. A careful analysis of the junk in the attic or storehouse of the average dairyman will reveal one or more relics of this kind, due to the persuasive powers of an agent who had convinced him that he was foolish in spending so much time at the churn. Figs. 190–202, and 245 show a few types in the evolution of the churn. In spite of all this activity for an improved article, the greater number of churns in use today are either the old-fashioned dasher churn (Fig. 196) or the equally old revolving barrel (Fig. 200, a modern hand type) or box churn (Fig. 198), or its later modification, the combined churn and worker (Figs. 202 and 245). Of these types, the barrel churn is by far the best. Practically all factory churns in this country are modifications of it.

Fig. 192. Churn of the end of the fourteenth century.

The barrel churn.—Taking the barrel churn as best for the farm butter-maker, he should know how to get the most out of it. In this form of churn the concussion of the cream necessary to do the churning is secured by the fall of the cream as the churn is revolved. The faster the churn is

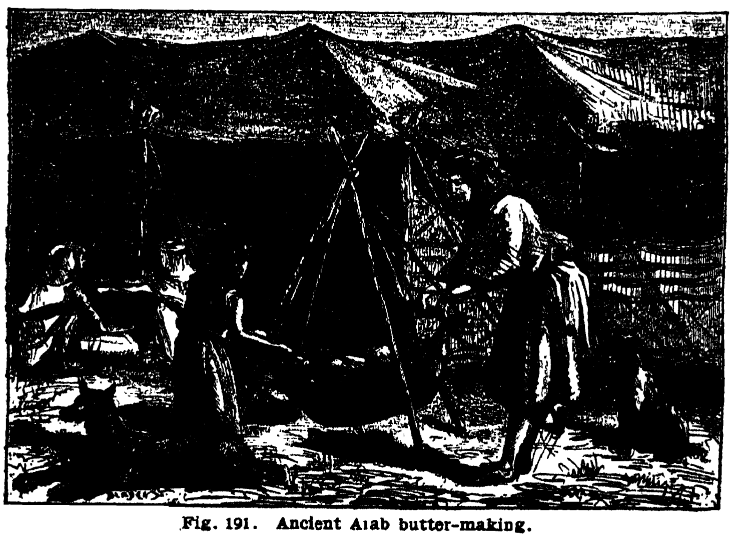

Fig. 191. Ancient Arab butter-making.

revolved, the greater number of concussions per minute will be secured within certain limits. If the churn is whirled so fast that the centrifugal force created holds the cream from falling, no churning will take place.

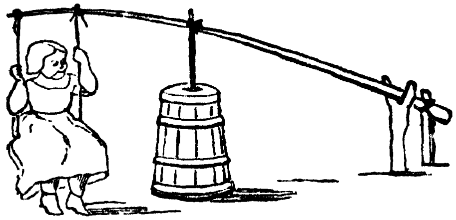

Fig. 193. A primitive device, said to have been used for churning.

Cleaning the churn.—Churns are usually made of wood, and their care is an important factor. When ready to clean, the churn should be rinsed out with cold water to remove all buttermilk, salt, and the like; it should then be partially filled with boiling water, the lid put on and fastened loosely, so that steam can escape, the draining plug withdrawn, and the churn whirled. The pressure on the inside caused by the creation of steam from the hot water will force water into every nook and crevice of the churn. After a few revolutions the water should be drawn off and another lot, boiling hot, added, and the whirling repeated. Empty this out and let the churn stand so that it will drain a few minutes and then turn the opening up and let it dry. The heat in the wood will dry it out rapidly, and there will be no chance for mold to grow. An occasional rinsing out with lime-water will help to keep a churn sweet.

All other wooden dairy utensils should be rinsed, scalded and dried with the same care.

Churning.—The process of churning is the gathering into a mass of the butter-fat in the cream. The butter-fat exists in the cream in minute globules, each independent of the others, and any agitation tends to bring them together, the force of the impact causing them to adhere to each other. As the agitation is continued, these small particles of butter grow larger by addition of other particles until a stage is reached when they become visible to the eye; and if the churning is continued long enough all will be united in one lump of butter in the churn.

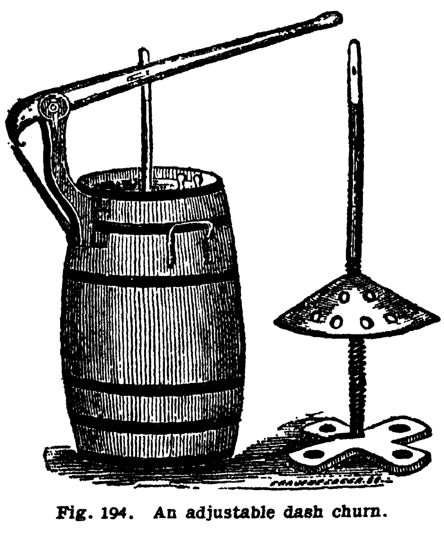

Fig. 194. An adjustable dash churn.

Temperature.—The time that it takes to churn depends largely on the temperature of the cream at the beginning. If the cream is warm, the butter will come very quickly; if it is very cold, the churning may have to be prolonged, in some instances for hours, before the butter granules will become large enough to free themselves from the buttermilk. The temperature at the beginning should be regulated accordingly. It is usually considered that about thirty to thirty-five minutes' churning should bring the butter. With different

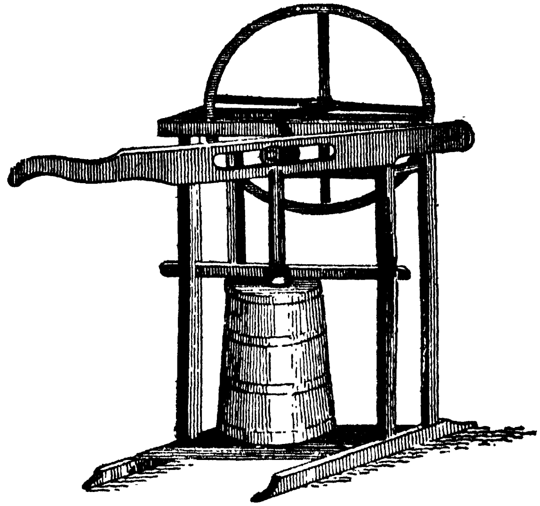

Fig. 195. Lever-power churn.

seasons of the year the temperatures will have to be varied somewhat, in order to have the butter come in this length of time. It is necessary in hot weather to churn at a temperature as low as 50° or 55° Fahr., while in the winter months, when the cows are on dry feed and the weather is cold, it is often necessary to raise the churning temperature to 60° to 65° Fahr. Cases have been known when, under some peculiar feed condition, the temperature had to be raised as high as 80° Fahr. in order to make the butter gather at all. Trouble of this kind rarely occurs when the cows have succulent feed in winter, such as silage or roots. Occasionally some peculiar fermentation takes place in the cream, causing difficult churning, but this is a result of carelessness somewhere, and can be remedied by a thorough cleaning up of the premises.

Washing and salting the butter.—It is important to know at just what point to stop churning. For best results in freeing the granules from the buttermilk and incorporating the salt, it is considered that the butter granules should be about the size of beans or grains of corn. The churn is then stopped,

and the buttermilk allowed to drain. After the buttermilk is well drained from the butter granules, an amount of water about equal in volume and of the same temperature as the buttermilk should be added, and the churn given four or five revolutions, slowly, so that the water will come in contact with every particle of butter and wash out the remaining buttermilk.

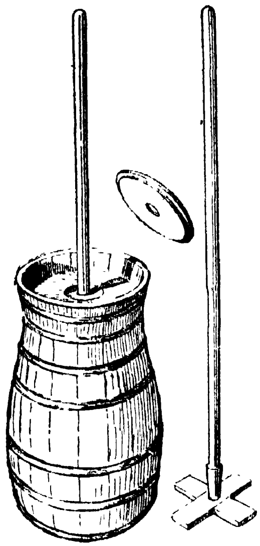

Fig. 196. Old-fashioned dasher churn, still in use.

As soon as the wash water has drained well from the butter granules, salt should be added. The amount of salt used will depend entirely on the demands of the consumer. Usually about one ounce of salt for each pound of butter will be necessary. If the ordinary barrel or box churn is used, the salt may be added in the churn. By giving the churn a few revolutions the salt will be thoroughly incorporated with the butter. It should stand in this condition for a few minutes, until the salt becomes more or less dissolved, before the working is begun.

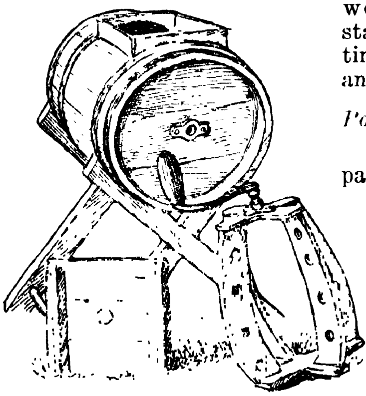

Fig. 197. Crank churn, drawn from one in use at present.

Working the butter.

Table workers.—For working the butter some form of table worker is best to use. The butter-bowl and paddle never give so good results because the butter almost invariably will be greasy, owing to the sliding motion of the paddle over the butter. The table workers commonly used are of two kinds—one having a stationary bed and a roller, either corrugated or smooth, arranged so that it can be passed back and forth over the surface of the butter (Figs. 203, 204); the other, having a movable bed, revolving on a center, usually under two corrugated rollers. [See Fig. 193, Vol. I.] Both of these forms will do good work if the operator understands their use.

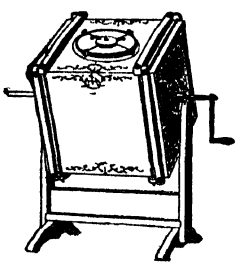

Fig. 198. Box churn.

Suggestions as to working.—If the salt and butter have been mixed in the churn, the butter may be placed on the working table and the working begun at once. After the butter has been pressed out with the roller it should be divided in the center, one part being laid over on the other and the rollers passed over again. The process should be repeated until the butter assumes what is termed a waxy condition. If the working is continued for too long a time the butter will become salvy, having the appearance of lard, and will lose its granular structure, becoming weak-bodied. The firmness of the butter must be taken into account in determining how long it should be worked. Usually the firmer the butter the more working it will stand and the more time it will need thoroughly to incorporate the salt and bring out the waxy condition.

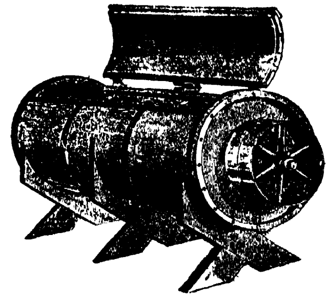

Fig. 199. Cylindrical factory churn.

Packing butter.

Value of appearance. The size and style of package to be used in packing butter will depend entirely on the market conditions where the butter is sold. While great stress has been laid on the quality of butter made, it must also be borne in mind that the method by which it is packed and the neatness with which it appears on the market have practically as much to do with its sale as has its quality. In fact, many buyers will select a neat package of butter in preference to one that is put up in a slovenly manner, even though the quality may not be so good. It is undoubtedly true that the average consumer will judge an article of food as much by its appearance as by its general qualities. An unattractive article does not appeal to the sense of taste. It should not be necessary to say that a package of any kind must be neat and clean in appearance, but a large part of the farm butter that comes into market shows that a great many makers do not

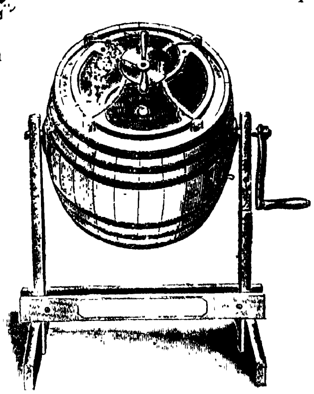

Fig. 200. A good type of hand churn.

Fig. 201. Square factory churn.

realize the importance of this part of their work. Many lots of otherwise good butter are sold every day at a discount because of the careless methods of packing. The demands of the market on which the butter is sold should be studied carefully and the package made of a size and form that will meet those demands.

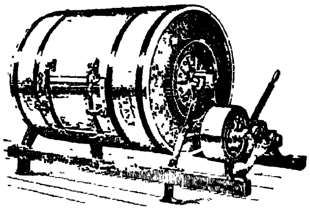

Fig. 202. Combined churn and butter-worker.

Butter in tubs.—If the butter is to be put up in tubs, the packing should be done so that the butter will be solid throughout its entire mass. Too frequently the butter is thrown in without sufficient packing, and large holes will appear in the body of the butter. While these may not affect the quality, they affect the appearance. If a parchment-paper lining is used in the tub it should be put in smooth and the top should be turned neatly over the edge of the butter. Coverings that are put on the top, whether circles of parchment or cloth made for the purpose, should exactly fit the top of the package. Care should be taken that the tub does not show finger-marks or other dirty spots.

Butter in small packages.—It is becoming more common for the markets to demand that butter be packed in small packages, such as pound prints or squares. Butter put up in this form should be wrapped neatly in parchment-paper. It is an excellent practice for the dairyman to have his name or label printed on the parchment. This helps to establish the identity of the goods, and, if the butter is properly made, it should aid the dairyman in finding a permanent market for his product. Wooden packages of almost any size can be secured for packing the prints. (Figs. 208, 209.) These should be used, particularly if it is necessary to ship the butter to market. For local distribution, light crates or boxes which will fit the prints and prevent their getting out of shape in hauling should be used.

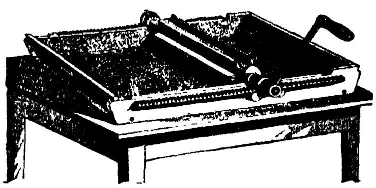

Fig. 203. Hand butter-worker.

Equipment.

The milk-room.—If milk is placed in a cellar or cave where there are decaying vegetables or fruits, it will quickly absorb the odors from them. Such places are entirely unfit for the storage of milk. The dairyman should have a building set apart from the barns or other places from which objectionable odors might come, for the exclusive use of the dairy. This building need not be very large, but must be constructed so that it can easily be kept clean and cool. A cement floor should be laid, as it is the easiest to clean, is cool, and does not rot from moisture. If the walls are built of stone, brick or concrete, so much the better, for such walls keep out the heat.

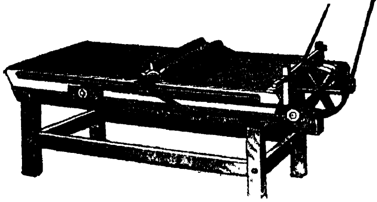

Fig. 204. Power butter-worker.

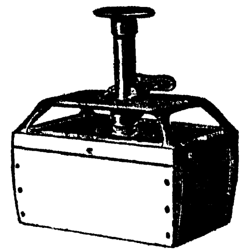

Fig. 205. An excellent hand butter-printer.

The roof construction should be such that it will effectually turn the heat of the sun. If the roof is not of concrete, it should be built double, so that an air-current will pass between the upper and lower parts. Walls and ceilings should be covered with cement plaster, whether wood or stone is used in their construction. This finish, if properly put on, is easy to clean and does not readily become affected with mold or decay.

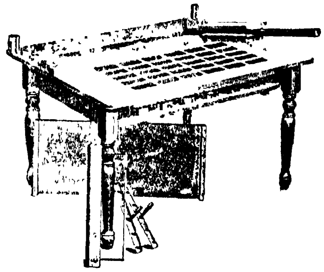

Fig. 206. Table butter-printer.

The water-supply.—Provision must be made for an abundance of water, and the pumping arrangement must be such that the fresh water from the well or spring will flow through the dairy-house. It should run into a tank built deep enough to allow the complete submerging of the milk and cream cans. The tank should have sufficient width and length to hold all that it may be necessary to use. A tank built up of concrete and finished with a cement surface is the most economical in the long run, and is much more satisfactory. Provision must be made for draining it out for purposes of cleaning. Wooden tanks are usually a source of trouble from leaks and decay. Iron tanks do not last long, because they become rusty.

Cooling arrangements.—If the dairyman has ice, the problem of cooling is very simple. Broken ice can be placed in the tank about the cans. There are plans for building ice-houses with refrigerators connected, but, all purposes considered, the refrigerator can be built with most economy and with better sanitary arrangement if it is constructed separate from the ice-house. The common ice-chest, in which the products to be cooled are placed in the box with the ice, is a very satisfactory way for handling cans of milk or cream. For other products it is not so satisfactory, as it is not dry enough, and, if the articles are small, does not afford shelf-room for

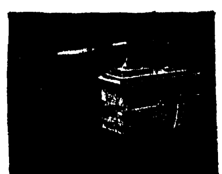

Fig. 207. Lever butter-printer.

them. [See *Refrigeration of Dairy Products*, pages 232–246.]

Use of steam.—In a moderate-sized dairy there should be added to the equipment a small steam boiler which should be in a room separate from the dairy. There is always need of steam, and the additional cost involved is but little compared with the benefits derived. If steam cannot be provided, a small hot-water heater of some kind should be used. It is essential to have plenty of boiling water for purposes of washing and scalding milk-vessels and the floors and walls of the building.

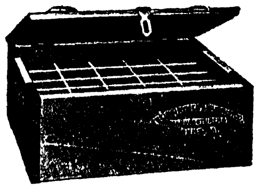

Fig. 208. Shipping box for butter-prints.

Character of utensils.—Not all of the bacteria that find their way into milk come from the cow or the barn. Often milk pails, strainers, cans and other utensils used for handling milk are the source of such trouble. Faulty construction of these vessels is very common. There should be no hidden, inaccessible places in milk vessels. The seams should be soldered over smoothly, inside and out. Cheap tinware is not usually well soldered, and if such is purchased it should be taken to the tinner to have all seams carefully gone over, closing up all that are open and can not easily be cleaned. Galvanized iron is sometimes used for milk pails and other dairy vessels, but it should not be, as the galvanizing is rough on the surface and affords hiding-places for innumerable bacteria. Wooden vessels should not be tolerated for holding milk, under any condition, for it is impossible to keep them clean. Rusty tinware, besides its effect in imparting rusty or metallic flavor to the milk, is objectionable for the same reason. Good tin is the only practicable material for milk vessels, and this must be kept shining and bright.

Cleaning the utensils.—The proper washing of milk utensils is something that is often misunderstood. All milk should be rinsed from the surface of the tin before it comes in contact with boiling water, as the heat will cook the milk on the surface, forming a coating very difficult to remove. If this coating is not removed, it furnishes food and place for bacterial growth. This is especially true around places likely to remain moist. After rinsing the vessel free from milk it may then be washed in hot water. There should be added to the water some good cleaning compound. Some of the so-called washing-powders are very objectionable, as grease of some kind is used in their make-up. When such powders are used a coating of thick grease will be formed around the edges of the sink or pan containing the wash-water. All such compounds should be discarded. Powders can be procured that are guaranteed to contain no grease, and they are usually excellent cleansers.

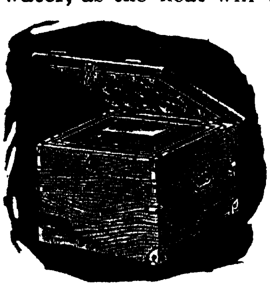

Fig. 209. Another type of shipping box.

For scrubbing the surfaces of milk vessels, a good brush should be used. There is nothing more objectionable for this purpose than a cloth, particularly the cloth that has been used for washing the dinner dishes, or the pots and pans. A good brush can be purchased for a few cents. It is the most effective and can easily be kept clean.

Drying and sunning utensils. The final rinsing of dairy vessels should be in boiling hot water. If they are allowed to remain a few minutes in the hot water, it is better. The heat will reach every part, and should be continued long enough to destroy bacterial life. After the rinsing in boiling water, the surface will quickly dry and should be allowed to do so naturally. Turn the vessel so that it will drain, and in a few minutes the heat in the metal will dry the surface. A cloth for drying can rarely be kept clean, and for this reason does more harm than good. It is an excellent practice to stand the pails and other milk vessels in the sun so that the rays will reach every part of the inside. Most species of bacteria cannot live in the direct rays of the sun. For this reason milk-rooms and similar rooms for handling milk products, except cold-storage rooms, should be built so that the sunlight can enter in abundance. Dairy-rooms are usually damp, and if dark, will permit the growth of molds and the development of bacteria, and will speedily become unfit places to keep milk. The troubles with stringy or ropy milk usually occur in places of this kind, and can be overcome by a thorough cleansing and the admission of plenty of air and sunlight. [For further discussion, see article *Creameries and Skimming Stations*, by H. L. Ayres, pp. 226–232.]

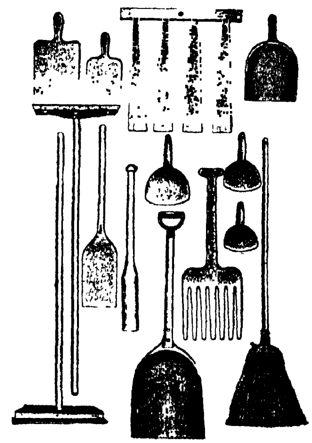

Fig. 210. Wooden-ware for use in a butter factory.

II. Creamery or Factory Methods

Everything pertaining to cleanliness and care of utensils in making butter on the farm applies to factory practice. The quality of the milk or cream received is of the utmost importance. The greater part of the present-day trouble with poor butter on the market begins back of the factory. The butter-maker can not make good butter from bad cream. Methods that will produce good butter on the farm will produce like results in the creamery, provided the butter-maker does his part properly.

Receiving the cream.

The man at the weighing-can, where the milk or cream is received, should be a good judge of quality and bad lots should be rejected. If circumstances are such that everything offered must be taken, the bad lots should be set aside to be churned by themselves.

Handling the cream before churning.

There are two general systems of handling the cream before churning — one for making pasteurized butter, and one for making unpasteurized butter. Pasteurization is becoming more common, and for certain pathogenic reasons may ultimately be required by law. The secret of pasteurization is the maintaining of a constant temperature throughout the process of sufficient degree to destroy all pathogenic organisms, as well as other varieties that may exist in the cream. [See page 184.] Many spore-bearing organisms escape destruction in the process, but, from the butter-maker's standpoint, the few remaining will not materially affect the desired results.

The making of starters has been described (pages 200-202). Their use is necessary, particularly with pasteurized cream. The starter should be introduced immediately after the cream is put into the vat. The cream may be churned immediately or left to ripen fully in the vat before churning. Recent experiments indicate that for storage purposes the sweet pasteurized cream, without the addition of a starter, may be churned at once, and the butter will be of a quality that will keep far beyond anything made from ripened cream. The details of the process have not all been determined as yet, but sufficient work has been done to show the practicability of the process.

Churning.

Practically all literature on butter-making leaves the reader in doubt as to the processes to be employed in churning. Too much is left to the judgment of the maker; he is led to think that there are no fixed laws governing the process of churning, and that the results are not capable of control. It may be put down absolutely that like conditions will bring like results. The object of churning is to separate the fat from the milk-serum and to secure a butter uniform in texture, color, salt, water, and other qualities. The common theory is that these factors depend on the acidity of the cream, the fat in the cream, temperature of the cream, temperature of the wash-water, time taken to work, amount of cream in the churn, and the like. The butter-maker is left to judge these matters for each individual churning. The result is butter of varying composition and body, unequal salting and uneven color, the degree of these variations differing with the ability of the butter-maker to guess as to what should be the next step in the process.

The acidity to which cream is ripened, and the percentage of fat in the cream, should not vary from day to day. The temperature of the churning should be such as to secure exhaustive churning, which will require the operation of the churn forty to fifty minutes. The temperature of the wash-water should be the same as the temperature of the buttermilk when the churning is complete. There will be no uneven coloring if this rule is followed. The amount of salt is controlled entirely by the necessities of the trade using the butter. The butter-maker must know the amount of butter-fat in the churn, and use the same amount of salt per pound of butter-fat each time, and the result will be uniform. The butter should be worked out at one working and packed immediately. The working should not extend beyond the point where the butter has a firm, waxy body. Overworking destroys much butter. If these different parts of the process are adhered to absolutely, day after day, the result will be a uniform line of butter, without a variation of more than 1 per cent in water, which will rarely exceed 15 per cent in all. Rigid system is necessary.

Temperature, acidity, and richness of cream are not causes of high or low water-content of the butter. They bear only a modifying influence on the amount and method of working, and can be entirely eliminated from the calculation of results, if they are brought to a constant factor. The water-content of the butter is under the control of the butter-maker, to increase or decrease within certain limits, as he wishes. If these facts constantly vary, the results will vary in spite of the skill of the worker.

Records.

The butter-maker should at all times keep records of his work. No success as a high-class operator can be secured otherwise. The work of making butter is more nearly an exact technique than is usually supposed, and the facts are reducible to system; and with system, the facts are sure and true.

Literature.

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THE MAKING OF CHEDDAR CHEESE

By *J. A. Ruddick*

The Cheddar belongs to the class known as the "hard" or pressed cheese, which includes such other kinds as the Cheshire and the Gloucester of England, the Dunlop of Scotland, and the Edam and the Gouda of Holland, the Gruyere of Switzerland and certain departments of France, and the Parmesan of Italy. There are several varieties of semi-hard cheese, the manufacture of which involves to some extent the principles employed in the manufacture of both the hard cheese and the soft moldy cheese.

It may be stated at the outset that this description of the process of Cheddar cheese-making does not cover the manufacture of the soft, weak-bodied cheeses, which sometimes go by the name of "Cheddar" in the United States. Such cheeses are really not Cheddars and should not be described as such. The true Cheddar cheese has a firm, waxy, meaty texture, which will keep for a year or more in good condition at a temperature of 60 degrees. The process as herein described, will make a cheese of this character from good milk. If a slightly softer cheese is required, it is necessary to leave rather more moisture in the curd and to prevent the development of so much acid. It is recognized that modifications of the process are necessary in various circumstances, but the principles involved are the same in all cases. Cheese cannot be made by formula. Experience and judgment on the part of the cheese-maker are essential, and he must determine, in every case, how much moisture to leave in the curd, how much acid to develop, how much salt to add, and the other factors, and he will be guided in his judgment, if he is wise in the matter, by the conditions under which the cheeses will be cured and the particular market for which they are intended.

Fig. 211. The village of Cheddar, showing the famous cliffs.

The composition of Cheddar cheese.

The percentage composition of Cheddar cheese varies greatly in different samples. The slightest modification in any of the different parts of the process of its manufacture, and the age of the cheese, are important factors in this connection. A cheese when green shows a much higher percentage of water than it will when well ripened, the difference often being as much as 5 or 6 per cent. The following figures have been compiled from various sources and represent an average:

THE COMPOSITION OF CHEDDAR CHEESE

Water		Fat		Proteids		Ash, etc.	
Max.	Min.	Max	Min.	Max.	Min	Max.	Min.
33.90	27.19	33.00	30.70	36.60	27.56	5.55	4.15

Historical.

The Cheddar cheese derives its name from the quaint old village of Cheddar (Fig. 211), in the southern part of the county of Somerset, England, which place first became famous for its manufacture. Just how long it has been made in that locality it is impossible to determine, but most authorities agree that it dates back over two hundred years. The process of its manufacture was brought to the United States, probably by English settlers, early during the last century, and to Canada some years later. In both countries it continued for some time to be made only on farms, as it is made to this day in its natal county of Somerset.

The manufacture of cheese has for many years been an important industry on the farms in the southwestern counties of Scotland. The Dunlop, a somewhat softer and higher acid cheese than the Cheddar, was the original variety, and takes its name from the village of Dunlop, in Ayrshire. The farmers of Ayrshire and Kircudbrightshire gradually acquired a knowledge of the Cheddar process, and "Scotch Cheddars" now compete with those from the south and west of England, and there is great rivalry and close competition at all the big British dairy shows between the English and Scotch schools of Cheddar cheese-makers.

The factory system.—The cheese factory is of American origin, and it came into existence about 1854. One Jesse Williams, of Herkimer county, N. Y., is said to have been the promoter. The factory system owes its growth to purely economic conditions. It suits the labor conditions of America, and its introduction made possible the rapid development of the industry which followed.

There are probably at the present time nearly four thousand cheese factories in the United States, the actual number in the last census year (1900) being 3,299. Wisconsin heads the list, with over 1,200 factories, of which a certain number are "Swiss" cheese factories. New

York state comes next in number of factories, but probably stands first in quantity of cheese produced. These two are the principal cheese states. Ohio comes next, with only 221 factories in 1900, and Michigan and Pennsylvania follow, with 130 and

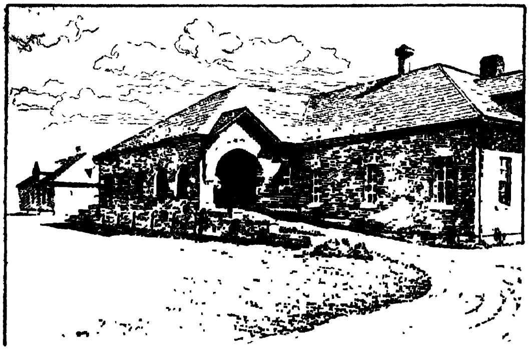


Fig. 212. A well-designed cheese factory.

124, respectively. The other 446 factories that were in existence in 1900 are distributed among thirty other states. A well-designed factory building is shown in Fig. 212. An interior is shown in Fig. 213.

In 1864, the factory system was introduced into the province of Ontario, Canada, by Harvey Farrington, of Herkimer county, N. Y., and, as in New York state, the factory system was quickly adopted by the farmers of Ontario, who up to that time had not engaged in the manufacture of cheese to any great extent. At present there are about four thousand cheese factories in Canada, mostly in the provinces of Ontario and Quebec, although cheese-making on the factory system is followed in every province of Canada except British Columbia.

In the year 1882, the first Cheddar cheese factory was established in New Zealand, pattern being taken after the American and Canadian system. The latest returns show that there are about one hundred and ten cheese factories in New Zealand, and some of them are probably the largest Cheddar factories in the world, turning out over five hundred tons of cheese per annum. Cheese-making on the factory system has also been introduced into the states of New South Wales, Victoria and South Australia, in the Australian Commonwealth, but for various reason the industry has not become of much importance in these last-named countries.

The cheese-makers of the southwest of England do not admit that the so-called Cheddar cheese made in other parts of the world is a true Cheddar; but the differences on which this assertion is based belong more properly to the practice of the art than to any real difference in principle. The manufacturing of milk into cheese in large quantities, as in the factory system, has necessitated the employment of some special appliances and labor-saving devices, but the true principles of Cheddar cheese-making have not been violated to any great extent. As a matter of fact, the actual variation in process which is to be found in the different countries now making so-called Cheddar cheese is not greater in principle than that which is to be found among the cheese-makers in the county of Somerset itself. While the English Cheddar cheese-maker may have some right to the exclusive use, which he asserts, of the term "Cheddar," on the ground of origin, we do not think the assertion can properly be founded on any real dissimilarity in the processes by which the cheeses are made in the different countries where this system has been adopted.

The factory system has resulted in producing greater uniformity and a better average quality of cheese than is to be found in the districts where farm cheese-making is still practiced, but it must be admitted that the possibilities of making a superior article are greater on the single farm than they are where the product of several farms is pooled in the factory system ; and the results prove it. It is well known in southwestern England, and in southwestern Scotland as well, that much finer cheese can be made on some farms than on others, and careful investigations by competent men have failed to show why such differences in localities should exist, although the superiority of certain farms has been generally attributed to the character of the soil and herbage to be found thereon. These finer distinctions, which the connoisseur easily recognizes, are lost sight of entirely where the factory system is followed; but, on the whole, there can be no doubt that the division of labor and uniformity of product, which the factory system permits, have compensated the American dairymen for any disadvantage inseparable from that system.

Many of the factories are coöperative or, at least, semi-coöperative, for the true spirit of coöperation is not often to be found in the cheese-factory or the creamery ; but that is another subject. The others are proprietary, and the owners charge, as a rule, a fixed rate per pound for the manufacture of cheese, providing all the equipment and labor

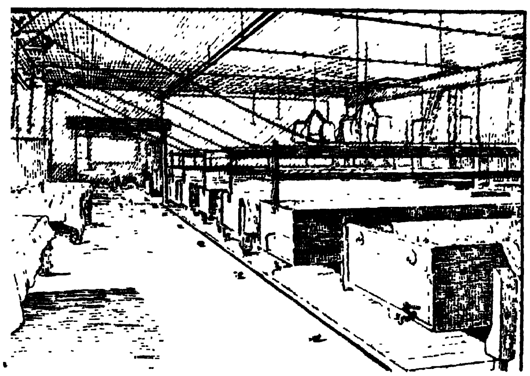


Fig. 213. Interior of modern cheese factory.

necessary for the manufacture and marketing of the cheese.

The output of the factories varies considerably in different localities. Generally speaking, the larger the factory the smaller the actual cost of manufacturing per pound, but an output of 200 to

300 tons of cheese per annum reduces the cost of manufacturing to a minimum and makes a satisfactory and convenient size of factory.

Total production of Cheddar cheese.

The total annual production of the Cheddar type of cheese throughout the world is estimated as follows:

	Tons
United States	135,000
Canada	122,000
England and Scotland	100,000
New Zealand and Australia	14,000
	371,000

The total value of this annual world's production of Cheddar cheese is, approximately, $75,000,000.

The process of Cheddar cheese-making.

We have already stated that the principles underlying the Cheddar process are more clearly defined and better understood than those of any other variety of cheese. The Cheddar process differs in one essential from practically all others, inasmuch as a considerable development of acidity is necessary in the milk before the rennet is added, and a higher percentage of acidity is allowed in the curd before it is finally removed from the whey. It is this feature of the Cheddar process which makes it so applicable to the factory system, in which the milk is most conveniently delivered only once a day, and at certain seasons of the year there is naturally considerable development of acidity in the milk before the cheese-making process can be started.

The methods in vogue in the United States differ slightly according to the market for which the cheese is intended. The American taste appears to favor the soft, quick-ripening cheese, without much regard to the real cheesy flavor, which is held in such high esteem among the cheese-eaters of Great Britain. For export, a firmer, slower-ripening cheese is desired, and some modifications of the process are necessary to secure these different results. As the English taste typifies the highest development in Cheddar cheese, a description of the process necessary to meet that demand will best exemplify the details of the Cheddar system.

True Cheddar cheese should be firm, without being dry; show a meaty, waxy texture when well-matured, and develop a clean, cheesy flavor when cured at a proper temperature.

In order to secure this ideal it is necessary that the milk should be produced under good conditions and kept free from contamination of any kind, or infection with the germs of injurious fermentations which develop objectionable flavors. During hot weather the night's milk, which is kept at the farm, should be cooled to a temperature of at least 60°, in order to prevent its developing too much acid when delivered with the morning's milk at the factory. It is generally recommended that the night's and morning's milk should be kept in separate vessels.

As the milk is received at the factory, it is passed over a weighing machine and delivered into a large steam or water-jacketed vat, where the temperature is raised by the application of steam or hot water until it reaches 86° Fahr. Tests are then applied and, if the milk shows the required acidity, the rennet is added in sufficient quantity to bring about coagulation in thirty to forty minutes. If the cheese is to be colored, the prepared annatto or other coloring-matter is added to and thoroughly mixed with the milk just before introducing the rennet. The extract of rennet which is now universally used is prepared from the fourth stomach of young calves. About three liquid ounces of the standard brands to 1,000 pounds of milk is usually sufficient to produce the desired result.

Ripening the milk.

If the acidity is found to be too low after the temperature is raised to the "setting" (renneting) point, the milk is allowed to "ripen," the test being applied from time to time, to note the development of the acid. In such cases the common practice now is to use a fermentation "starter," of one-half to 1 per cent of sour milk, which has been specially selected and prepared for the purpose. Possibly no other practice in the whole art of cheese-making has given rise to so much discussion and difference of opinion as has this matter of using a starter, owing to a confusion of what is mere practice on the one hand, with what is a true principle on the other. The principle of the starter is correct, but the practice has often been wrong, and those making the mistakes have been unable to see that they were violating the principle underlying the practice. Others have judged the principle by the results of wrong practice. It has come to be generally recognized, however, that a well-prepared starter is a great aid to the cheese-maker in advancing the acidity of the milk, and also in overcoming wrong fermentations, which, if allowed to proceed unchecked, will result in objectionable flavors. The judicious use of a good starter gives the cheese-maker a measure of control over the flavor and even the texture of his cheese, and this is very desirable.

The fermentation starter.

There are two ways of preparing a fermentation "starter." The cheese-maker may purchase a so-called "pure culture" from his dairy supply house, from which to make his mother starter, or he may propagate it himself. (1) If the former method is adopted, it will be necessary to secure a quart or two of pasteurized milk, to which the pure culture is added. This is allowed to stand in a sealed jar until it has curdled, when it is added to the right quantity of pasteurized milk to provide the necessary one-half per cent of starter for the next day's cheese-making; hence the name "mother starter." Before the starter is added to the milk, a quantity is preserved to be added to more pasteurized milk for the following day, and so on indefinitely, or at least as long as the starter retains its desirable flavor and character. (2) The mother starter may

be prepared by pasteurizing several separate lots of milk, which are afterward cooled to about 70°, by pouring or exposure to air, which is as free as possible from objectionable taints or odors. By exposing the pasteurized milk in an atmosphere where the chances are best for getting the right class of fermentation, the milk is again seeded, and, in most cases, with satisfactory results. These samples are then kept in sealed jars until curdling takes place. It may require several days to reach this stage, and it should be noted that practical experience teaches that the lower the temperature, down to about 60°, the better are the chances of obtaining good flavors. The best of the several lots should be selected, if any are good enough, and the procedure is the same as with the mother starter prepared from the commercial pure culture.

It is a good practice to have a covered box or tank, with steam and cold water connections, of a capacity to hold one starter can for each vat of milk. Each can should contain the right quantity to make one-half per cent of the milk in the vat. With these conveniences, the heating and subsequent cooling are very easily accomplished.

The starter will be most effective if used very soon after the milk is curdled. Some care and judgment are therefore necessary to ensure that the right quantity of mother starter is added and the right temperature maintained to produce curdling at the proper time.

The starter has been abused by ignorant and careless cheese-makers. Some have failed to realize that if a bad-flavored starter is used it is almost certain that bad-flavored cheese will be the result. The use of a too large percentage of starter may give the cheese an acidy texture. A proper starter having a clean, pleasant, acid taste and flavor is a great advantage to the cheese-maker, but it requires skill and care to prepare and use it. The greatest care must be taken to sterilize all vessels or utensils coming into contact with it. The starter should not be allowed to become too old, because putrefactive ferments are likely to gain the ascendency.

The acidimeter.

Nothing has helped more to systematise the process of Cheddar cheese-making than the comparatively recent introduction of acidimetry, or the adaptation, for the use of the cheese-maker, of the process known to the chemists for determining the strength of acids. With this test the cheese-maker may learn the exact acidity of the milk as received at the factory, and is enabled to regulate the ripening, or the addition of starter, in an intelligent manner. An accurate guide is also provided for the proper development of acidity in the curd, by applying this test to the whey.

For the purpose of making the test, a standard alkaline solution is provided and kept in a well-stoppered bottle. A burette to measure at least fifty cubic centimeters, a white cup or dish, a ten-cubic centimeter pipette, a bottle of phenolphthalein indicator and a glass stirring-rod complete the outfit. Ten cubic centimeters of the milk or whey to be tested is measured into the white cup and a few drops of the indicator are added. The alkaline solution is now allowed to drop slowly into the milk, which is stirred constantly during the operation. The phenolphthalein gives no color reaction in an acid medium, but as soon as sufficient of the alkaline solution has been added to the milk to neutralize the acid, a pink tinge appears. The addition of the alkaline solution is stopped as soon as this pink tint is permanent. The number of cubic centimeters and fractions thereof, of the solution, required to produce the pink color, indicates the percentage of acidity, each cubic centimeter representing .1 per cent of acid. Milk will show, on the average, .19 to .21 per cent of acid when ready for the addition of the rennet, but the exact percentage can be determined only by experience for each locality. The whey, immediately after cutting and stirring begins, will show a lower acidity than the milk did before the rennet was added, because of the acid reaction of the casein which is retained in the curd. The percentage of acid in the whey immediately after cutting should be .14 to .15 per cent, or about .05 per cent less than shown in the milk. Any variation from that is the guide to the cheese-maker either to hasten or retard the subsequent heating and cooking of the curd. The whey should be removed when its acidity is about .01 less than the acidity of the milk at the time of adding the rennet. If it is "working" fast, rather more margin should be given. There are various modifications of this test, for which apparatus and supplies may be procured from dealers in dairy utensils.

Cutting the curd.

The object of cutting the curd is to facilitate the removal of the whey. For this purpose the American curd-knives are now most generally used. These consist of a set of two (Fig. 214), each having a number of blades held in a frame three-eighths to half an inch apart, the blades running perpendicular in one knife and horizontal in the other. A later modification of the curd-knife is made of fine wires, about three-eighths inch apart, stretched on a steel frame. When the curd is firm enough, the perpendicular knife is passed lengthwise and crosswise of the vat, and the horizontal knife in one direction only, leaving the curd, theoretically, in cubes, the size of which corresponds with the distance between the blades of the knives. Frequently, the horizontal knife is used first. Great care must be exercised in the cutting, because the curd at this stage is very jelly-like and easily displaced, and there is likely to be much unevenness in the size of the cubes and loss of solid matter unless the work is done carefully. As the finer the curd is cut the more quickly

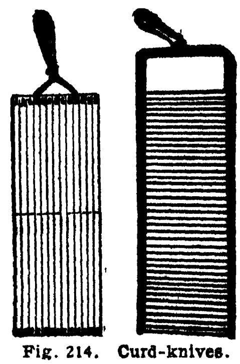


Fig. 214. Curd-knives.

it becomes firm, it is obviously important, for the sake of uniformity, to have the curd cut or broken as evenly as possible. If the milk is over-ripe, it is an advantage to cut the curd somewhat finer than if the conditions are normal. Some makers follow the practice of allowing the curd to stand for a few minutes between the two cuttings, while others finish the work when once begun, without any delay.

Heating the curd.

After the cutting is finished, stirring should begin, being very gentle at first else the bruising of the curd, in its tender state, will cause serious loss of the solid constituents. After ten or fifteen minutes of careful handling, the curd becomes firmer and the freshly cut surfaces more or less "healed over," so that the stirring can be proceeded with more vigorously. As a matter of fact, it is necessary to accelerate the stirring as the heating progresses, because, as the curd becomes firmer and more solid, its density is increased and there is more tendency to settle and pack in a mass in the bottom of the vat. Toward the end of the heating period, which should cover about forty minutes,—at the rate of one degree every three minutes,—stirring cannot be too vigorous.

The "cooking" temperature, so-called, requires to be varied according to localities and the character of the milk. In some places it has been found necessary to raise the temperature as high as 108° to 110° Fahr. in order to get the curd sufficiently firm and to expel a proper amount of moisture, while in other districts much better results are obtained at a temperature of 96°. A very common rule is to fix 98° as the standard temperature and then to vary it according to circumstances. The maker must use his own judgment in matters of this kind. If he finds that his cheese is turning out too firm and dry, a lower cooking temperature will have some effect in the opposite direction, but there may be other reasons for the dryness of the cheese, and that is where the exercise of judgment is required. If, on the other hand, it is found that

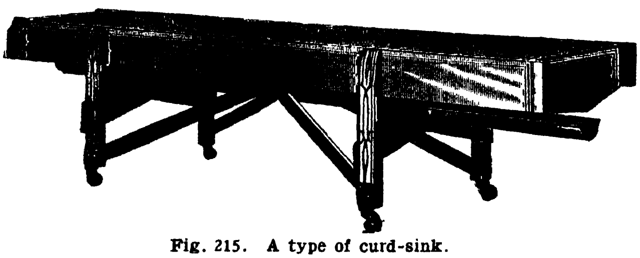


Fig. 215. A type of curd-sink.

the cheese retains too much moisture and is inclined to show excess of acidity, the cooking temperature may be raised a degree or two and the result noted.

There are several things in the process of cheese-making which affect the amount of moisture retained in the curd, and success or failure in cheese-making hinges on that point. In the first place, the size of the particles into which the curd is cut or broken has considerable influence. The cooking temperature also affects the amount of moisture retained in the curd. If a part of the whey is removed from the vat as soon as the heating is finished, or even before, the increased pressure on the curd and the extra handling which it receives also tend to expel the moisture.

Drawing the whey.

It should take two and a half to three hours from the time the rennet is added until sufficient acidity is developed and the curd has become firm enough

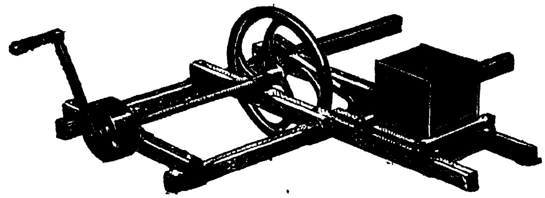


Fig. 216. Curd-mill.

to permit of the whey being entirely removed. If it takes longer, it is wise to allow the ripening of the milk to advance a little farther before the rennet is added. If it takes less time, it is evidence that the milk is over-ripe, and every effort should be made to have it delivered in a sweeter condition, and the process should be modified on the lines already mentioned, so as to retard the development of acidity by hastening the removal of the whey. It is the development of acidity beyond a certain point in the curd, before it has become sufficiently firm or free from moisture, that makes a sour cheese. The curd should be firm enough to have a slightly elastic consistency when pressed in the hand by the time the acidity has reached .19 or .20 per cent.

The "hot iron test" was generally used, until recent years, to determine the proper stage for the removal of whey, and many cheese-makers still depend on it. This test, which is of American origin, is simplicity itself, as far as apparatus goes, but the difficulty experienced in acquiring the knack of applying it usually surprises the novice. The test consists in pressing a handful of curd, from which the surplus whey has been squeezed, against a heated iron surface. Given the right temperature in the iron, and proper manipulation, the curd sticks to it and at a certain stage begins to spin fine threads when slowly drawn away. In the best practice, the whey is removed when these threads may be drawn out one-eighth to one-fourth of an inch, which is equivalent to about .19 to .20 per cent of acidity as shown by the acidimeter.

As the whey is being removed, the curd is stirred and finally placed on racks, which are covered with a linen cloth, to facilitate the drainage of the whey. The racks may be placed for this purpose on the bottom of the cheese vat, or they may be in a special frame, technically called a "curd-sink" (Fig. 215). One advantage of the sink is that it can be fitted with castors and wheeled from place

to place, which permits of a different plan of building and arrangement of machinery as compared with a factory in which the racks are used in the vat. Both methods have their advantages and disadvantages, but the choice is one of convenience and suitability for a particular building rather than for any essential difference as far as the art of cheese-making is concerned. In either method, a cover should be provided to retain the heat in the curd and to prevent its drying on the surface.

Only experience can teach the right amount of stirring or handling of the curd at this stage to ensure the proper amount of moisture in the cheese. A prominent instructor used to say to his students: "Always stir the curd until it 'squeaks' between the teeth," and the rule is a very good one.

Maturing the curd.

When the curd has been allowed to stand long enough for the particles to adhere and form a solid mass, it is cut or broken into pieces of convenient size for handling, and then turned from time to time, in order further to facilitate the removal of the whey, and to preserve an even temperature and color. At the second and subsequent turnings the pieces are usually piled two or three layers deep.

When the curd draws about one inch on the hot iron, or the whey which drains from it shows .6 per cent of acid, it is milled (Figs. 216, 217) and then frequently stirred until it becomes mellow and velvety, when the salt is applied at the rate of one and one-half to three pounds per 1,000 pounds of milk, according to the season of the year, and the yield of cheese from the milk, the smaller quantity being used in the spring, when the milk is poor, and when the cheese is usually wanted for quick consumption. The whey dripping from the curd should test 1 to 1.25 per cent of acid before the salt is added. After the salt has been thoroughly mixed with the curd, it is allowed to stand for about twenty minutes.

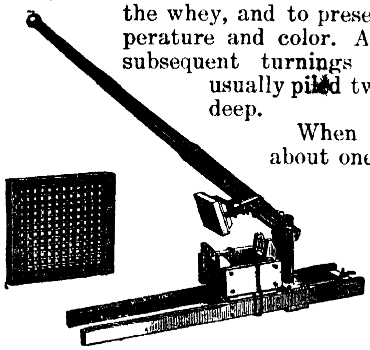


Fig. 217. Curd-cutter.

Pressing the cheese.

The curd is now ready for the molds or presses (Figs. 218, 219). A standard Cheddar cheese has a diameter of fourteen and one-half to fifteen and one-half inches, varies from ten to twelve inches in height, and weighs seventy to ninety pounds; but there is no limit to the size or shape into which this cheese may be molded. The varieties in the United States take the form of "twins," which are of standard diameter, but half the usual height, so that two go in a standard box; "flats," also of standard diameter, but shallower; "daisies," smaller in all dimensions; "Young Americas" or "Stilton shapes," six or seven inches in diameter, weighing ten to twelve pounds, and many other sizes. For show purposes, Cheddar cheese is often made to weigh 1,000 to 1,200 pounds. About forty years ago, a 7,000-pound cheese was made at Ingersoll, Ontario, and exhibited as a curiosity in England; but the record was reached in 1892, when the writer assisted Professor J. W. Robertson, then Dairy Commissioner for Canada, in "building" the 22,000-pound cheese, at Perth, Ontario, which was exhibited at the World's Fair at Chicago, the following year.

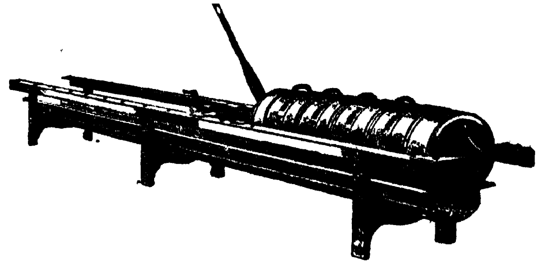


Fig. 218. Cheese-press.

When ready for pressing, the curd is weighed into the molds or "hoops" to insure uniformity in size, and the pressure applied, lightly at first, but gradually increased until the full strength of the press is reached. In the course of about one hour, the cheese is temporarily removed from the hoops, and the bandage trimmed and adjusted so as to secure a neat and attractive finish. The cheese is then left under heavy pressure over night. In the best factories it is again trimmed in the morning, re-pressed and finally removed in time to make room for the next day's curd.

Curing the cheese.

It has often been said that cheese is only half made when it is placed in the curing-room. At any rate, the best of cheese is seriously injured in quality if exposed to a temperature of over 60°, and there is 1 to 2 per cent of unnecessary shrinkage. The texture becomes more or less "mealy" and objectionable flavors are likely to be developed. It has been demonstrated that curing, or ripening, will proceed at very low temperatures, even below 32°, but more slowly as the temperature is reduced.

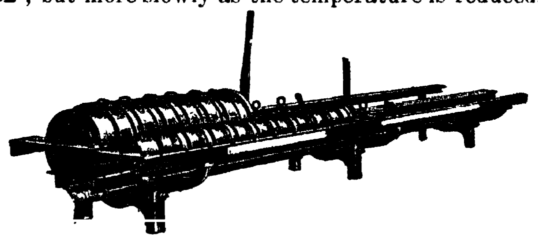


Fig. 219. Steel combination cheese-press.

Extremely low temperatures are inadvisable, because, while such practice may result in an absence of bad flavor, it also has the farther negative effect of preventing the development of the characteristic cheesy flavor which is an essential quality in first-class typical Cheddar. The ideal

cheese has a positive as well as a negative quality of flavor. On the whole, a temperature of 60° seems to be best suited to produce this desired result.

A curing-room with walls slightly insulated, with tight-fitting doors and windows and with a

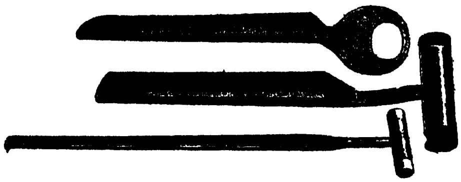


Fig. 220. Two cheese-triers and one butter-trier (the longest one).

cement floor to utilize the cooling power of the earth, will ensure the proper temperature except in very hot weather. To remove the moisture which exudes from the cheese, and that which results from the reduction of temperature, and also to insure a proper temperature, it is advisable to provide a well-insulated ice-chamber adjoining the curing-room, with a provision for the circulation of air, under control, between the curing-room and the ice-chamber. The air is thus cooled in hot weather and the moisture which it collects is deposited on the uncovered surface of the ice. If properly constructed, the ice-chamber need be only about one-third the size of the curing-room in cubic capacity, assuming, of course, that the curing-room is no larger than is necessary to hold the cheese.

The cheese factory.

The early cheese-factory buildings were more or less makeshift in character, and usually constructed entirely of wood; but these are gradually being replaced by a more permanent and more sanitary type of building. The cement floor is very properly superseding the wooden floor, both for making-rooms and curing-rooms. No cheese factory can have perfect drainage unless the floors are impervious to water, and no ordinary wooden floor can remain waterproof for any length of time. The cement floor is impervious and permits of proper drainage, without which the factory premises cannot be kept in a sanitary condition.

The surroundings of factories have been very much neglected, but there is evidence of an

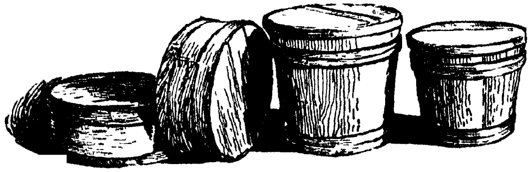


Fig. 221. Butter tubs and cheese boxes.

improvement in this respect, and owners and managers of factories are beginning to take more pride in the appearance of the buildings and grounds surrounding them.

The following specifications were prepared by the writer, from plans that were recently designed and that have proved in actual practice to be very satisfactory. [See Report of the Dairy Commissioner for the Dominion of Canada, 1906, Ottawa.]

SPECIFICATION FOR A CHEESE FACTORY WITH A COOL CURING-ROOM, TO BE CONSTRUCTED OF WOOD. (Fig. 222.)

Materials.

Wood.—All lumber employed must be thoroughly dry and sound, without loose knots or shakes, and should be odorless.

Spruce and hemlock are the best, in the order named. Pine is not so suitable for inside sheathing, because of its odor.

All boards employed should be dressed as well as tongued and grooved.

Unseasoned lumber must be carefully avoided. When building in winter, fires must be kept going, so as to have all materials as dry as possible. This is very important, as dampness in insulation destroys its efficiency.

Paper.—All papers used to be strictly odorless and damp-proof.

Damp-proof insulating papers can be had in rolls of 500 to 1,000 square feet, thirty-six inches wide. The following brands can be recommended, viz.: "Neponset," "Hercules," "Ko-Sat."

Tar paper, felt paper, straw paper, rosin-sized paper, and all other common building papers, are not suitable and should not be used.

Use double thicknesses in all cases, each layer lapping two inches over preceding one. The layers should extend continuously around all corners. All breaks to be carefully covered.

Shavings.—Shavings must be thoroughly dry, free from bark or other dirt. Shavings from some odorless wood, such as hemlock, spruce or white wood, to have the preference.

Bales of shavings received in a damp condition should be opened and the shavings exposed to the air and stirred occasionally until they are dry.

The spaces in the walls should be filled gradually as the inside sheathing is being put on, and the shavings well packed.

About eight pounds of shavings, closely packed, will be required for each cubic foot of space filled. For a room 8 x 8 x 7 feet, with anteroom 8 x 4 x 7 feet, built on this specification, 3,000 pounds will be needed.

Cinders.—Coal cinders should be used wherever possible to cover the earth over area of ice-chamber, in preference to sand, gravel or tan-bark.

Construction.

Foundations.—The building to rest on stone or concrete foundations.

Floors.—Floors throughout the building to be of cement concrete. The area under the ice-chamber need not be provided with the usual finish or wearing surface, as it is intended only to give solidity to the ice-chamber floor.

Floor of ice-chamber.—Lay a false floor six inches above concrete and fill space between concrete and false floor with cinders, dry ashes, tan-bark or dry sand.

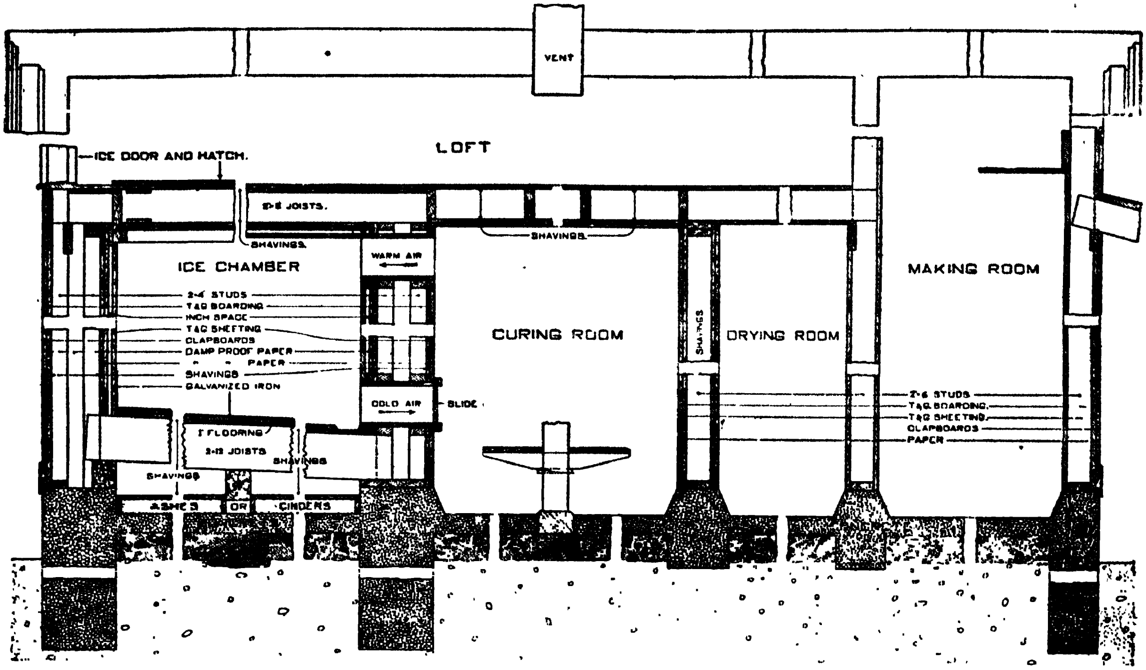


Fig. 222. Detail of construction for frame building. (Buildings shown in Figs. 222–227, designed by J. A. Ruddick.)

Fix 2 x 12-inch joists as shown on plan. Cover with two courses of matched lumber, with two-ply of damp-proof paper between. Cover the whole with galvanized iron, with soldered seams, and flashed along the walls about eight inches.

The main floor of the ice-chamber should have a slope of one inch in every four feet, to a gutter connected with the drain, to carry off the water from the melting ice.

The drain must be trapped to prevent passage of air.

Drainage.—Provision for drainage to be made by forming the usual gutters in the cement floor of the making-room and press-room. The floor should be made with a slope of one inch in every four feet toward the gutter. A glazed tile drain with cemented joints should be provided, to carry all drainage to a safe distance and thus avoid creating a nuisance near the factory, or running the risk of contaminating the water-supply.

Walls.—Set up 2 x 6-inch studding, and cover outside with one course of matched lumber, two ply of damp-proof paper and siding, or clapboards. For inside finish of making-room, line up with matched lumber. For finish of curing-room, cover inside of studs with two courses of matched lumber, with two ply of damp-proof paper between. For inside finish of ice-chamber, set up another row of 2 x 6-inch studs, to alternate with outside row, as shown in the detail of Fig. 223. Cover inside of studs with two courses of matched lumber, with two ply of damp-proof paper between. Over this lay another ply of damp-proof paper, one-inch furring-strip and finish with one course of matched lumber. The inside row of studs should be placed so as to leave a space of twelve inches for shavings between the inside and the outside sheathing.

Partitions.—Partition between making-room and drying-room to be of 2 x 4-inch studs with one course of matched lumber on both sides. Partition between drying-room and curing-room to be of 2 x 6-inch studs with two courses of matched lumber and double ply of damp-proof paper on each side of studding. Partition between ice-chamber and curing-room to be same as walls of ice-chamber.

Ceilings.—Ceiling of making-room to be vaulted by laying one course of matched lumber on under

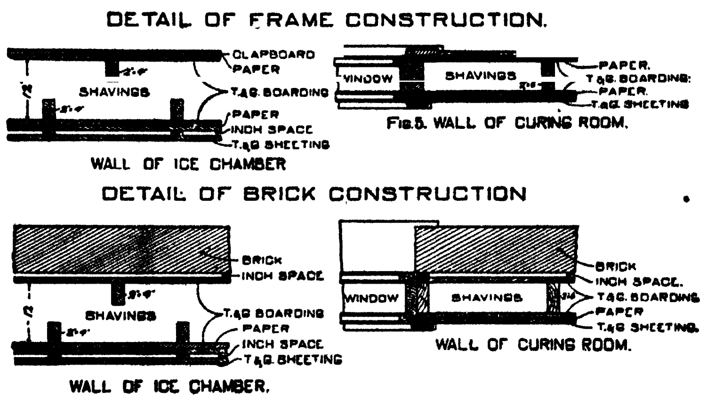


Fig. 223. Detail of wall construction.

side of rafters and cross-pieces fixed at suitable height. Ceiling in drying-room to consist of one course of matched lumber on under side of joists. Ceiling of curing-room to consist of two courses of matched lumber, with two ply of damp-proof paper between. Ceiling of ice-chamber to be the same as

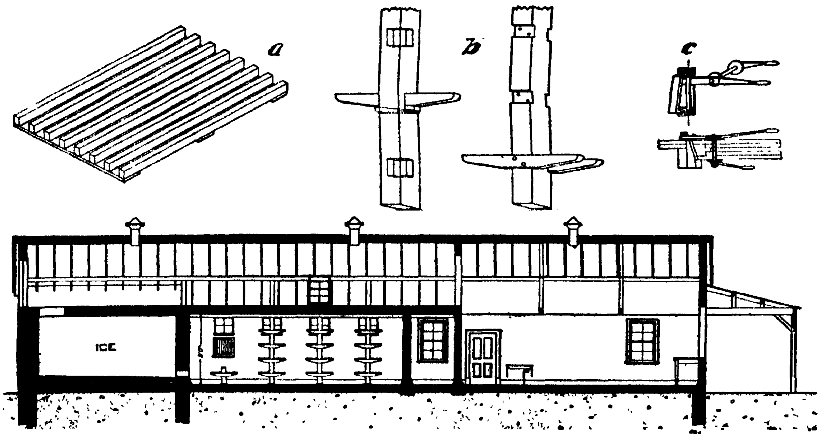


Fig. 224. Longitudinal section of wood-construction cheese factory. *a*, **Detail of racks;** *b*, detail of posts and brackets; *c*, door fastening.

walls of ice-chamber. On upper side of joists lay two courses of lumber, with two ply of paper between, over area of ice-chamber; over curing-room and drying-room one course of matched lumber.

Spaces to be filled.—Fill all spaces between joists and studs in walls, floor, ceiling and partition of ice-chamber, and all spaces between studs and joists in walls, ceiling and partition of curing-room, with planing-mill shavings, as shown on plan.

Windows in curing-room.—Should not be over two feet square, and placed between the rows of shelving, close to the ceiling, as shown on plan. The sash should be double and each double-glazed, and be carefully fitted. They should be hinged at the top. Each window should be fitted with a wooden shutter to keep out direct rays of the sun, but not to keep out the light.

Curing-room doors.—Doors to be built up with two-inch skeleton frame, covered on both sides with two courses of matched lumber, with two ply of damp-proof paper between. Edges to be beveled and covered with felt. Doors to be fitted with a wrought-iron door fastener, as shown at Fig. 224.

Double doors should be fitted to all openings into the ice-chambers. These doors, which are not often opened, should be provided with a special fastener consisting of bolts with a long thread and tail-nuts, in order that they may be screwed up tight.

SPECIFICATION FOR A CHEESE FACTORY WITH A COOL CURING-ROOM, TO BE CONSTRUCTED OF BRICK OR CEMENT AND WOOD. (Fig. 226.)

The specifications for materials are the same as for wood construction.

Foundations and floors.—[See specifications for wood construction, p. 214.]

Floor of ice-chamber.—Lay over concrete bed six inches of dry coal cinders and ram solidly to make a firm bearing on which to place one layer of four-inch hollow brick, laid in cement. Finish with one inch of cement, covering the surface well with neat cement to make it as nearly damp-proof as possible. The floor should slope one inch in every four feet to a gutter on one side, connected with the drain, to carry off the water from the melting ice. The connection with the drain must be trapped to prevent passage of air.

Drainage.—[See wood construction, page 214.]

Walls.—The brick or cement walls will need no interior finish in the making-room, press-room, drying-room, wash-room and engine-room, except a smooth coat of plaster, preferably of cement. Such a finish is sanitary, durable and easily cleaned.

For the insulated rooms, i. e., the ice-chamber and curing-room, it is very desirable that the inside surfaces of the brick or cement walls should be waterproofed by coating with pitch (not tar),

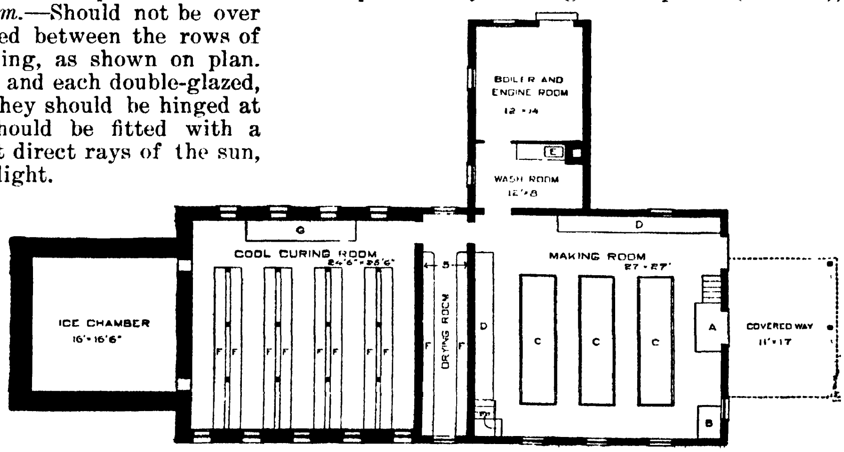


Fig. 225. Plan of ground floor of wood-construction factory.

asphalt or paraffin wax. These substances are not easily applied, especially in cold weather, because of their quality of hardening very quickly. A plastering of cement improves the damp-resisting quality of brick or concrete walls.

For the insulation of the curing rooms, lay one-

inch furring-strips on wall, and nail thereon one course of matched lumber. Set up a row of 2x4-inch studs and finish with two courses of matched lumber, with two ply of damp-proof paper between. The space between studs to be filled with shavings. (Fig 223, lower right-hand section).

For insulation of ice-chamber walls, lay one-inch furring-strips and cover with one course of matched lumber. Set up one row of 2 x 4-inch studs against the sheathing, and another row to alternate with first row, with outer edges twelve inches from the sheathing, so as to form a space of twelve inches for filling with shavings. Nail on studs two courses of matched lumber, with two ply of damp-proof paper between. Over this lay another ply of damp-proof paper, one-inch furring-strips, and one course of matched lumber, leaving a one-inch air-space, which is for the purpose of checking the dampness that comes from the ice, and that must be kept out of the insulation. (Fig. 223, lower left-hand section).

If the inside surface of brick or cement is made thoroughly damp-proof, as described, the furring-strips and single course of matched lumber may be dispensed with, and also the first row of studs next the wall of the ice-chamber, if the construction will permit, as they are not necessary to the insulation.

Partitions.—Partition between making-room and drying-room to be of brick or cement. Partition between drying-room and curing-room to be the same as curing-room walls. Partition between curing-room and ice-chamber to be the same as walls of ice-chamber.

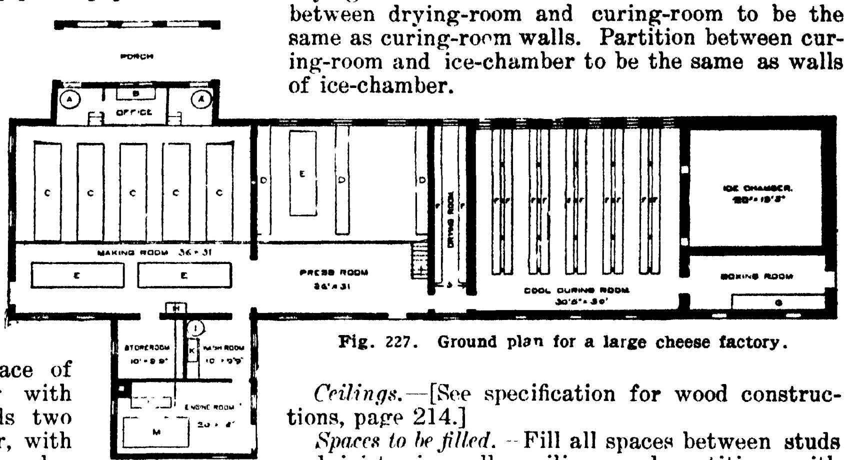


Fig. 227. Ground plan for a large cheese factory.

Ceilings.—[See specification for wood constructions, page 214.]

Spaces to be filled.—Fill all spaces between studs and joists, in walls, ceilings and partitions with dry, planing-mill shavings.

Windows in curing-room.—[See specification for wood construction.]

Curing-room doors.—[See specification for wood construction.]

It is important that the doors should make an air-tight joint when closed. The slightest opening will result in unnecessary consumption of ice, and at the same time allow sufficient warm moisture-laden air to enter to cause dampness and an unduly high temperature.

For literature, see page 219.

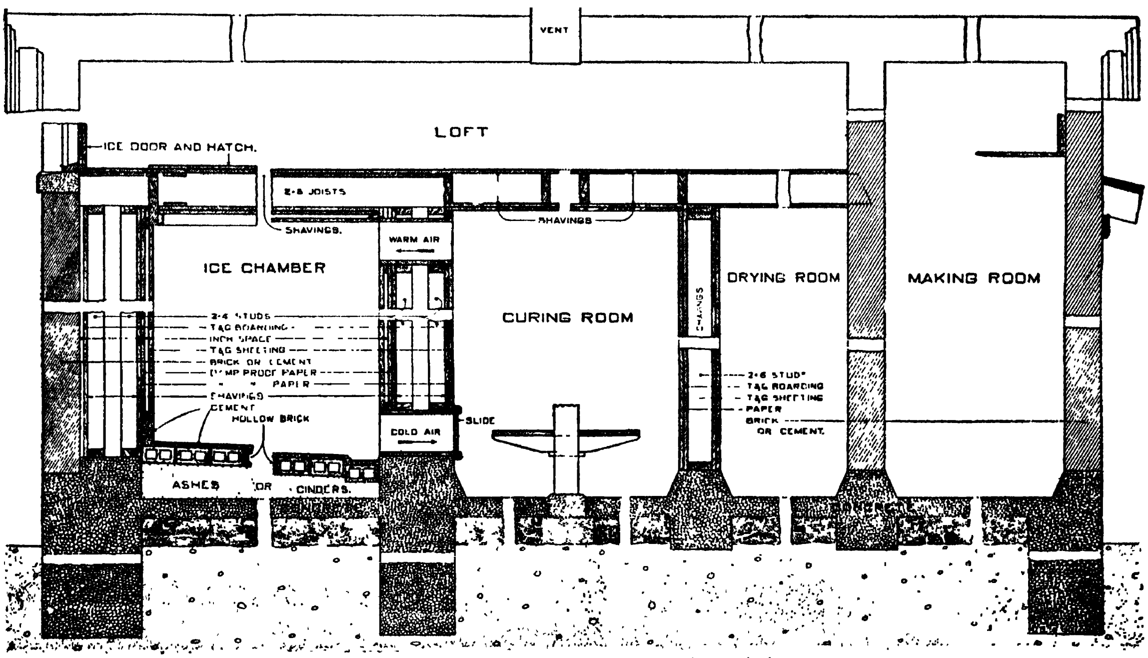


Fig. 226. Detail of construction for brick building.

OTHER VARIETIES OF HARD CHEESE

By *Charles Thom, and others*

The number of varieties of cheese, grading from hard through semi-hard to soft, is almost innumerable, inasmuch as slight variations in the processes of cheese-making greatly influence the character of the product. For the same reason, there is much variation in the quality and character of a given variety, depending on the details in its making. The same cheese may be put up in different forms, in order to reach special markets. Thus, we have several modifications of the common Cheddar cheese — the *young America, pineapple, picnics, truckle* — small hard cheeses, made in different forms. Then there are the English varieties — the *Leicestershire, Gloucester, Derbyshire,* and *Wiltshire,* modifications of the Cheddar cheese that are seldom found in America. *Sage cheese* is not essentially different from the Cheddar, except that it is flavored with sage extract or sage leaves. The *American home-trade,* or *stirred-curd cheese,* is very similar to the Cheddar in the details of its manufacture; and yet a slight modification, by which more moisture is retained, results in a very different cheese—one that is softer and milder. By removing fat from the milk, we get *skimmed* or *partially skimmed cheese. Prepared cheeses* are fancy brands made by softening and reworking good common cheese, with the addition of butter or other fat and some flavoring substance.

In this way the gradations from one type of cheese to other entirely different types might be traced. One can readily see the almost infinite number of types or varieties that might result. It would be to no purpose to mention all of these. We add here a few of the other hard cheeses that are recognized as such on the American market. For fuller notes on these and other types, the reader should consult the references given on page 219.

English dairy.

English dairy or imitation English dairy cheese is one of the modifications of the hard cheese that has been developed in recent years. Considerable cheese is now made under this name. It reaches a special trade that demands a cheese having some approach to the texture and flavor of the choice British varieties. The makers have developed a practice on English lines which produces cheese for a trade that is comparatively limited, but which may be expected to enlarge with the increase in the demand for the finer flavored varieties. Its market name suggests its approach to the qualities sought, without using the name of any particular type of English cheese.

Swiss (Schweitzer) Emmenthaler or Gruyere.

The most important European cheese in the American market is the Swiss. Although distinguished into Emmenthaler and Gruyere by the expert, the ordinary trade recognizes only a general type of Swiss cheese, for which any of these names is commonly used. These cheeses are large, weighing fifty to one hundred and twenty-five pounds, or even more. The cut surface shows numerous holes throughout the cheese. These vary in size up to an inch in diameter. They result from fermentation induced in making the cheese. The cheese itself is rather hard or firm in texture, mild but characteristic in flavor.

The product of the Swiss factories has won a place in all the markets of the world by its superior qualities. Its importation probably exceeds all other varieties that reach the American market. It is the best known of all the foreign cheeses to the native American. The demand for this cheese, coupled with the settlement of Swiss farmers in many parts of America, has resulted in the establishment of numerous factories, especially in New York and Wisconsin, for the manufacture of domestic or imitation Swiss cheese. Although the product has thus far failed to equal the characteristic flavor of the imported cheese with sufficient uniformity to rival it in price, the production of domestic Swiss has outstripped, in recent years, all other varieties, except American Cheddar, and is rapidly increasing, with every prospect of equaling the imported cheese in quality within a few years.

Edam.

Edam, as an imported cheese, comes from northern Holland. The cheeses are round, painted red, weigh about three pounds each, and are rather hard. Although whole milk is supposed to make the best cheeses, Edam, as it reaches the trade, is usually partially skimmed. In texture it is compact, and often very dry. In flavor, it is a mild type of cheese, although ripened for several months. Its keeping quality makes it familiar on all large markets, since there is no loss in handling.

Cheeses labeled "Edam" are made to some extent in America, and resemble closely the imported article, although distinguished by experts.

Gouda or Pantegras. (John W. Decker.) (Fig. 228.)

Gouda cheese originated in South Holland, and takes its name from the city of Gouda. It is made

Fig. 228. A, Gouda or Pantegras cheese; B, Gouda mould; C, bottom of mould into which, D, the top fits.

to some extent in America for shipment to the West Indies, where it is known as Pantegras cheese. It is larger than Edam, and pressed as flattened spheres. It is a sweet-curd cheese, which is salted in brine and cured in the same manner as Edam.

It must be made from good milk, as gassy fermentations spoil it. In the hot summer months its manufacture is dispensed with for this reason. It is packed four in a case, the case having little holes covered with wire screen for ventilation.

Munster.

Munster is one of the softer varieties of hard cheese, imported from Germany in a small way, but made on a considerable scale in America. It is made in small sizes, with a smooth, slightly open texture. It is ripened for a short time, and then sold. It is a mild cheese, intermediate, perhaps, between the Cheddar type and such cheeses as Brick. (Page 224.)

Parmesan, Grana and others.

The Italian hard cheeses, Parmesan, Grana, Romane, Reggiano and other varietal names, are imported in considerable quantities, and reach all of the large markets. These cheeses are large, very hard and dry, being ripened for long periods, two to three years commonly. In this ripening an even distribution of small gas-holes is secured by particular ferments. The ripening commonly gives a sweetish flavor. As a market article these cheeses satisfy the taste of the Italian immigrant, and an increasing native demand for a cheese suitable for grating and use in cooking, especially with macaroni. No attempt to manufacture this cheese has been made in America.

Cococavallo, Scamorze or *Buttiro.* (John W. Decker.)

For this Italian cheese, the milk is skimmed and then coagulated with rennet, and the curd is firmed and allowed to settle to the bottom of the vat. The whey is then drawn off. The curd is cut into pieces and piled on a draining-table. After a number of hours of draining, it is cut into small strips and thrown into a vat of hot water. The small strips of curd melt together into a mass resembling taffy. The cheese-maker then draws it out in a string and molds it by hand. The usual shape is that of "Indian clubs," but it may be in the forms of animals. Each form, as fast as made, is thrown into a vat of cold water, to set it in the shape into which it has been drawn. After a number of hours in this cold water, it goes into a brine bath for salting. After salting, it is hung up by a string to cure. It may be marketed green, or may be cured several months. A small cheese may weigh only a pound, a large one five or six pounds. A small ball of butter is sometimes worked into the curd, when it is termed Buttiro cheese. The cheese is shipped in barrels.

Italians coming to America have brought with them their methods of cheese-making. In Sullivan and Orange counties, New York, and in Geuga county, Ohio, there are factories making such cheese.

Ricotte. (John W. Decker.)

This is an albumen cheese made by heating the whey drawn from the former cheese, to about 200° Fahr. The addition of sour whey helps to coagulate the albumen, which is skimmed out and put into perforated tin cylinders about six inches in diameter. These tin molds are slightly tapering, and are set one into another for pressure. The albumen block is then rubbed with salt and set on a shelf to dry for weeks. A steam-heated kiln may be used to facilitate the drying. The cheese is wrapped in parchment paper, and packed in barrels for shipment.

Other varieties and brands.

An increasing number of special articles reach the trade under factory names alone. These vary from skilfully made skimmed cheeses, which satisfy

Fig. 229. Italian (Scamorze) cheese, hung from attic rafters to cure.

the demand for a mild-flavored cheese at a moderate price, to the elaborate and attractive packages of processed cheese, which bring fancy prices. In the absence of standards and type names of known significance, these may be said to appeal to the appetite for variety among foods - the special market rather than to the regular market for standard products.

Literature on hard cheeses. (J. A. Ruddick.)

The literature of cheese-making is not extensive, nor is the fact surprising, considering that the knowledge of the subject was almost wholly empirical until within the last twenty-five or thirty years. As a matter of fact, the only literature of much practical value to the cheesemaker has appeared within the last ten or fifteen years. The publications of the United States and the Canadian Departments of Agriculture and the agricultural experiment stations of New York and Wisconsin and other cheese-making states, are among the most important contributions to the present-day cheese literature.

John Oliver, Milk, Butter and Cheese; Aikman and Wright, The Book of the Dairy, Translated from the German of Fleischmann; James Long, Elements of Dairy Farming; H. D. Richmond, Dairy Chemistry; F. J. Lloyd, Cheddar Cheesemaking; M. A. O'Callaghan, Dairying in All Its Branches; J. H. Monrad, A B C of Cheesemaking; J. W. Decker, Cheddar Cheesemaking; H. H. Wing, Milk and Its Products; H. H. Dean, Canadian Dairying; L. L. Van Slyke, Testing Milk and Its

Products; *H. W. Conn*, Bacteria in Cheesemaking; *Farrington and Woll*, Testing Milk and Its Products, *Alvord*, Cheesemaking on the Farm, Farmers' Bulletin No. 166, United States Department of Agriculture.

SOFT CHEESES IN AMERICA

By *Charles Thom*

One definition would describe soft cheese as cheese containing so high a percentage of water as either to be soft from the start or to become semi-fluid or buttery in the ripening process. This statement is ample for many varieties, but becomes inadequate in examining certain others (such as Roquefort) whose method of making or ripening allies them most closely with this group. Another definition describes soft cheese as a cheese produced by curdling milk at low temperatures (not above 32° C. or about 90° F.) without a subsequent heating of the curd to expel the whey. Curd so made, in some types is cut and partially drained and in others is dipped directly into hoops. In all cases, soft cheeses are allowed to drain without using a press. Such cheese, then, is made of soft curd as distinct from curd which has been hardened by extra heat after curdling. Yet this definition would exclude most varieties of Cottage cheese. Used, however, in its most general sense, the designation "soft cheese" may be applied to any cheese that is soft when in the proper condition for consumption, either from the water remaining in it or from the action of ripening agents; or, to any cheese made from soft or unheated curd and put together without pressure.

Most varieties of soft cheese consist, in the freshly made condition, of 45 per cent or more of water, with the remainder variously divided into fat, proteid and ash. More characteristic still for the ripened cheeses is the completeness of the breaking down or digestion of the proteids (casein and the like), brought about by the agents of their ripening. The nitrogenous constituents of the fully ripe soft cheeses are highly soluble in water; i. e., a well-marked digestion of the casein has taken place. They may be designated as predigested. On the other hand, most, if not all, hard cheeses contain, even when freshly pressed, less than 40 per cent of water, and undergo in ripening much less complete digestion of the proteid.

Some varieties might be classed as either hard or soft cheeses. Roquefort, for example, when ripe shows the water content and solidity of many true hard cheeses, but its making and the completeness of its ripening process show it more truly a soft cheese. Gorgonzola and Stilton are closely allied to Roquefort, whereas Brick and Limburger, with the texture and, to a large extent, the ripening of soft cheeses, are allied by their making process to the hard cheeses.

Home cheese-making.

Soft cheese-making in America, as a factory industry, is of comparatively recent origin, although home cheese-making has been and still is widely practiced. The kinds of soft cheese made in the homes are as various as the sources of our wonderfully mixed population. The common Cottage cheese, under its various names, is a well-known article of family use in dairy regions. In the different parts of the country, persons of different stock vary the making process widely, however, and have introduced their national varieties of home-made cheese. With comparatively few exceptions, the home manufacture of soft cheeses hardly affects even the local markets except as it forms the foundation of a demand for the imported or the factory product.

Importation.

The importation of the European varieties of soft cheese has been largely a growth of the last generation. Even so, the growth of this trade has been limited to a comparatively few choice varieties, although numerous varieties are imported in small amounts. Of these cheeses, the Roquefort has now become familiar in all our larger markets, and is not uncommon in the hotels and grocery stores even of our smaller cities. Camembert is widely used in the larger cities, but is almost unknown in the smaller cities. Gorgonzola reaches the large cities and those places where a special Italian trade demands its importation. English Stilton can be found in a very few markets. Of the remaining French cheeses, Port du Salut, Pont L' Eveque, Brie and Coulommier are imported in a small way to New York city. Norwegian Gammelost is rarely found. Of the German forms, Limburger and Munster are well-known in the American market, although the imported forms of both are largely displaced by the domestic product. Of the multitude of varieties of soft cheese found in the European markets, only a small percentage, therefore, reaches America, and even of these but two or three constitute the larger part of the entire importation.

The total importation of cheese given for the year 1906 (Yearbook, United States Department of Agriculture, 1906, p. 670) was 27,286,866 pounds, invoiced at prices averaging fifteen and three-fourth cents per pound. Of this total, not more than one-fourth can be given as soft cheese. Comparison of this with our exportation of 16,562,451 pounds of cheese, at prices averaging eleven and three-fourths cents per pound, shows the disparity of market values between the higher-priced European cheeses and the American hard cheese, our only export article.

An important barrier to the increase of trade in imported soft cheeses is the very perishable nature of the choicer varieties. Many of these cannot be imported at all unless shipped unripe to withstand the conditions of transportation, and consequently the ripening is often abnormally completed. Trade standards, therefore, are difficult to establish, since products from equally reliable makers or even from the same maker often differ very greatly. In spite of these difficulties, however, the trade in the better varieties of cheese is still growing rapidly.

As found in the American market, the various

types of soft cheese may be separately discussed. It is noteworthy that only the ripened varieties of soft cheese are actually imported, and of these only the best. These few varieties have so established their reputation that a review of the markets of several countries of Europe shows the same cheese commanding the higher prices in each market examined. (United States Department of Agriculture, Bureau of Animal Industry Report, 1905, p. 108).

Cheeses always eaten fresh.

The soft cheeses that are eaten fresh are entirely of domestic make. Although appearing under various trade names, there are three types already common, namely: Cottage cheese, domestic Neufchâtel, and Cream.

Cottage cheese.—Of these, Cottage cheese is largely a home product. As a home product, Cottage cheese is made from milk curdled by natural souring, then skimmed, heated to expel the whey, strained by hanging in cloths, and salted to taste with or without the addition of cream or butter. Some makers add caraway seed, anise, or other flavor. The variations are as numerous as the places of making. In the factories, large amounts of Cottage cheese are made by curdling separated milk with rennet. This skimmed milk curd is then drained in cloths, packed and shipped to the general market, where it is worked over and sold in various styles of fancy packages under trade names, often as Neufchâtel. At best, the trade in Cottage cheese has never been more than as a by-product of other dairy work. Its possibilities have scarcely been touched as yet. It is also known as Dutch cheese, schmierkase, and pot cheese.

Domestic Neufchâtel.—On the other hand, Neufchâtel and Cream constitute a really profitable industry of considerable magnitude in the states of Vermont, New York, Michigan, Wisconsin, Iowa, and in parts of Illinois. The use and manufacture of these varieties of cheese is spreading over wide areas in the northern states and Canada. New York produced nearly 2,000,000 pounds of Neufchâtel in 1906.

As these cheeses appear in the market, Neufchâtel is found in rectangular packages wrapped in paper and tinfoil. These weigh about three ounces and retail at five cents each, as a rule. The cheeses of different brands differ greatly in composition; no standard proportions are recognized for water, fat, and protein, although they commonly contain about 50 per cent of water. Neufchâtel is always a factory product, depending for its acceptability on the attractiveness of the package and the smoothness and palatability of the cheese itself.

In the making, milk of varying fat test is curdled in several hours with a very small amount of rennet. The resulting granular curd is strained in cloths, cooled to avoid loss of fat, pressed, and finally molded by machinery to produce an exceptionally smooth texture in the package. European Neufchâtel is a different product, and is not imported.

Cream.—Cream cheeses are produced in exactly the same manner as Neufchâtel, except that a larger amount of butter-fat is usually incorporated in the cheese. The better grades test 35 per cent of fat, or more, although brands differ so widely that some makes of Neufchâtel are superior to the poorer grades of "Cream" cheese. Cream cheeses may be wrapped in paper and tinfoil, making square packages, or in many cases molded to fit white jars closed by sealed covers. Packages of four ounces sell at ten cents, making the common price per pound forty cents or more. The trade in Neufchâtel and Cream cheeses has been limited to the cooler months of the year. It is gradually enlarging to become one of the most profitable of dairy manufactures. With its large yield of cheese from one hundred pounds of milk, at good prices, great increase in such manufacture may be expected in the future. Such extension will depend largely on the multiplication of cold-storage facilities in the retail trade, which will make handling the product safe and profitable for a longer part of the year.

Ripened cheeses containing green mold.

Roquefort. Roquefort cheese is imported from France. It is made from sheep's milk, with at times slight admixtures of goat's milk or cow's milk. This cheese is about eight inches in diameter and three inches thick, and weighs about five and one-half pounds. The ripe cheese presents a clean, white surface, but when cut is found to have an open texture with all its numerous air-spaces lined with green mold (*Penicillium roqueforti*, Thom), giving the cut surface a marbled appearance. Associated with this marbling is the peculiar piquant flavor due to the mold. It is to this ripening and its unequaled flavor that Roquefort owes its preëminence as the best known of all varieties of ripened cheese.

The industry centers in the department of Aveyron in southern France, and extends over an irregularly defined district, perhaps one hundred miles in diameter, reaching to the island of Corsica. From time immemorial the cheeses produced on the farm have been taken to the village of Roquefort, and ripened in caves which extend far into the rocky cliff, along whose sides cluster the dwellings and shops of the workers. In the past century, however, the industry has been thoroughly organized, so that at present a few companies control the larger part of the factories and all of the caves used in ripening the cheese. So complete has been this organization, and so thorough the study of methods of making and ripening, that the cheese bearing the name of Roquefort has earned the highest reputation for uniformity in quality wherever it is known.

"In the making of Roquefort cheese the milk is curdled at 24° to 28° C., in one and one-half to two hours. The curd is cut with curd knives into lumps the size of a walnut. After the whey has partially separated, the curd is emptied into vessels covered with cloth to hasten the draining, where it is shoveled over to equalize the cooling and draining. After the whey is removed, the hoops are filled with the curd and allowed to drain with absolutely no

pressure. While the curd is going into the hoops it is well sprinkled with spores from a powdered bread culture of the Roquefort Penicillium. This is done with an instrument resembling a pepper-box, at the rate of ten grams of bread to about one hundred kilograms of cheese curd. Such a cheese is turned three times during the draining process on the same day. In three to five days the cheeses are sufficiently hard to be handled freely. On these days the cheeses are turned three times each day, and the hoops washed once a day. The cheeses may now go at once, but are commonly allowed to accumulate a few days, and are then crated and carted or shipped to Roquefort.

"In the caves the cheeses are salted at least twice with a coarse hard-grained salt. In this process they are first salted on one side and then laid in piles of three for the salt to diffuse into the cheese. At the second salting the other side receives the salt. They are allowed to drain some time after salting. After the surface has dried somewhat, they are run through a brushing machine, which leaves a clean surface. They then go through the prickle machine. This machine has a disc set with long, parallel, needle-like spikes, which make numerous holes through the cheese to let in the air for the growth of mold.

"Roquefort cheese when a few days old is hard enough to stand handling and transportation. In the salting process the cheeses remain in piles of three without support and without change of form. In section, as far as determined, they show air spaces: that is, the pieces of curd are not completely welded together by the treatment while making. When the cheeses drain, these spaces are left as the whey runs out, and the cheese is thus from the first specially suitable for the entrance and growth of mold. It may be noted here that these large firms employ trained men and furnish them well-equipped laboratories to study the technical phases of the work.

"When the cheeses are ready for ripening, they may be sent to the caves at once or be put into refrigerators. If the cheeses are intended for the immediate market, they go at once to the caves; but if they are to be held for the season when no cheese is made, they are sent to the refrigerator. In the latter case the cheeses are wrapped closely in tinfoil and carried into great storage-rooms, where the refrigerating machines run constantly to maintain a temperature of about 3° or 4° C. The makers declare that a cheese may be kept in this way for five months with very little ripening. This does not entirely stop all changes, but the changes are at least very much retarded. When needed to fill the demand, the cheeses are taken from the refrigerator, the tinfoil is removed, and they are placed in the caves.

"In the cave the cheeses stand on edge on the shelves. They are there exposed to a moist atmosphere at a temperature of 15° C., or lower in some cases. Here the development of flavor takes place. In so moist an atmosphere there is very little drying, but the cheese becomes heavily coated with a yellowish or reddish slime, which is probably mostly bacteria and *Oidium lactis.* No development of other surface molds is allowed. The surface is scraped once or twice while the cheese is in the cave. A cheese coming from cold storage will show flavor in three to four weeks. It is then scraped clean, wrapped again in tinfoil, and sold." (Charles Thom, Soft Cheese Studies in Europe, U. S. Dept. Agric., Bureau of Animal Industry, 1905.)

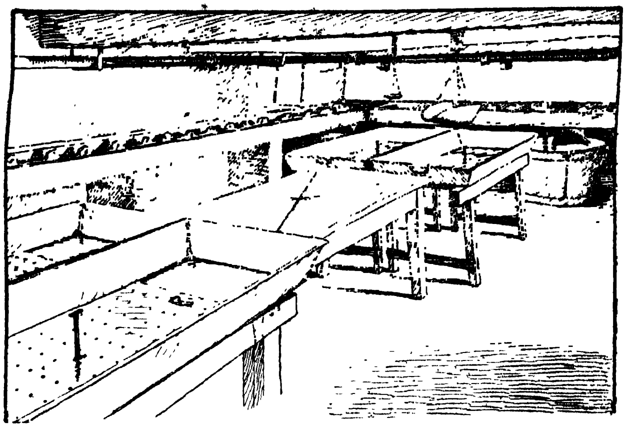


Fig 230. Lead vats in Stilton cheese factory. England.

Although some experimental work has been done on the making of this general type of cheese (by the Dairy Division, United States Department of Agriculture and the Storrs Agricultural Experiment Station, at Storrs, Conn.), no Roquefort is at present known to be produced for sale in America. Certain brands of potted cheese, labeled Roquefort, have been prepared and widely sold, and resemble the imported cheese closely in flavor.

Gorgonzola.—Gorgonzola is a cow's milk cheese imported in large amounts from northern Italy. The name comes from the village of Gorgonzola, but little or no cheese of this kind is now made there. Gorgonzola cheese-making is spread over a wide area extending from the neighborhood of Milan to the pasture regions of the Italian Alps.

The cheeses are about twelve inches (30 cm.) in diameter by six to seven inches (18 cm.) in thickness, and weigh fifteen to twenty pounds (7–10 k.). Before they are sent to the market these cheeses are painted to form a hard crust of a red-colored substance (said to be barite and tallow) which prevents evaporation in shipment. When cut, a cheese of this kind is rather firm and close in texture, streaked or marbled with green mold which follows the holes made by a punching instrument and such natural openings as remain in the curd itself. In flavor, Gorgonzola at its best very nearly equals Roquefort and resembles it closely, but lacks that friable buttery texture which distinguishes Roquefort. It is not so carefully made, nor so uniformly ripened, but is commonly of very uneven texture and often shows areas of marked injury from bacteria.

Descriptions of Gorgonzola cheese-making differ widely as given by different authorities. The industry is not closely organized but rather, in large measure, follows local practices handed down for generations. All agree that whole milk is used, is curdled with natural rennet, that the curd is cut, thoroughly drained, and dipped into hoops where it drains without pressure. After several days draining, during which the cheeses are turned each day in the hoops, they are taken out and rubbed with salt on alternate days for about two weeks. They are then carted or shipped to the ripening establishments built in the cool valleys of the Alps, many of them near Lecco. In these buildings, the cheeses are ripened for a period of three or four months. While on the shelves, such cheeses are turned repeatedly during the early stage of ripening. At the end of the first month, they are punched with an awl-like instrument several inches in length, so that holes reach every part of the cheese and allow the green mold to enter. The cheeses are not inoculated with mold, but the mold finds its way into the cheese after the punching has been done. When ready for the market the cheeses are painted over twice to cover them thoroughly with a hard crust, and shipped.

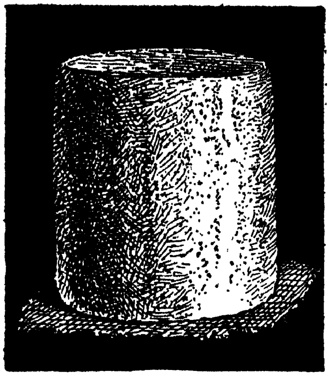


Fig. 231. Stilton cheese.

Stilton.—Stilton cheese is made from cow's milk in the midland counties of England. The curd is cut, drained thoroughly and then soured over night. The sour curd is kneaded with the hands, salted, put in hoops fifteen inches high and seven inches in diameter, and allowed to drain without pressure. Several days are necessary for a cheese to assume a firm enough texture to be taken from the hoop, rubbed, wrapped with a cloth and placed on the shelf to ripen. The ripening period is four to six months, during which time more or less constant care is necessary. (Figs. 230–232.)

A ripe Stilton has a heavy rind, commonly infested with cheese-mites for the outer one-half inch. As brought to America this rind is usually carefully trimmed off and the cheese painted over with a greasy, red or yellow substance. When cut, a Stilton should show streaks and seams filled with green mold (Roquefort mold); it is usually of rather firm texture, and, at its best, compares favorably with Roquefort and Gorgonzola in flavor.

Stilton cheese-making centers in the regions about Leicester and Melton-Mowbray, and continues from April first to October first. Although Stilton has been produced in Canada to some extent, little practical success has been made with it in America. Except as satisfying special demands, little Stilton reaches America. It is obtainable, however, in the larger markets, especially of the Atlantic states. Stilton is largely excluded from the general market because it is generally inferior in quality to Roquefort and Gorgonzola, although sold at the same or higher prices.

Gammelost.—Gammelost, the *old cheese* of Norway and Sweden, is imported in small quantities by dealers with a large Scandinavian patronage. It is a dry, hard, crumbling cheese, streaked and discolored with masses of mold. The whole mass is more fully penetrated by several species of mold than other types of mold-ripened cheese, making a product much less attractive to the general consumer. In some cases, cheese-mites were also found throughout the cheese. Among these agents, the Roquefort cheese mold is common.

Among other types of cheese containing green mold, some Hungarian Brinse (Brindse or Brimse) is imported, but thus far only in small amounts.

Cheeses with moldy rind only.

Camembert and Brie.—Of the imported soft cheeses, Camembert is second in popularity only to Roquefort. In less than twenty years the annual importation has risen from 60,000, in 1890, to over 3,000,000 in 1905–6. Since 1900, Camembert has been produced successfully in New York state, first by a single French factory, and more recently by others. The present production may be estimated at little less than 1,000,000 per year. The nearly related French Brie was introduced by the same factory, and has been made successfully by them. So closely similar are these cheeses that, aside from their measurements, the same description will answer for both, although produced by slightly different making processes.

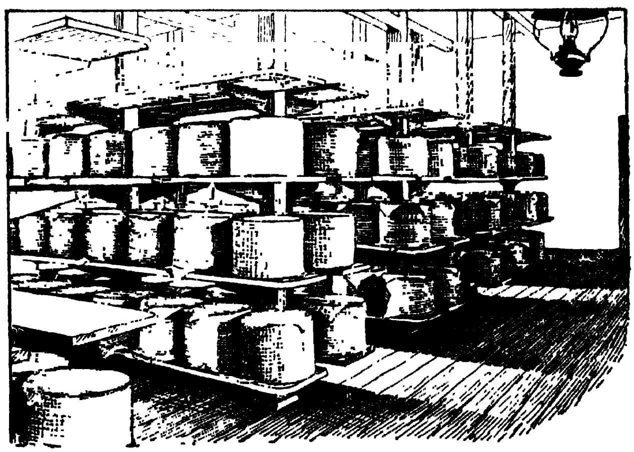


Fig. 232. Interior of Stilton cheese curing-room.

Camembert cheeses are made in two sizes: Camembert, four and one-fourth inches (10–11 cm.)

in diameter, and half-Camembert, about three inches (7.5 cm.) in diameter; both sizes about one and one-fourth inch in thickness. Brie is usually slightly thinner than Camembert but larger in diameter, being made in several sizes from nine to eighteen inches. Each Camembert cheese is always enclosed in a close-fitting wooden box to protect the ripened cheese during shipment.

"The cheeses of this group are superficially recognized by their moldy rind. In the earlier stages of ripening this is white, cottony with the mycelium of a species of Penicillium (*Penicillium camemberti*, Thom). At the end of one or two weeks the color becomes a gray-green from the ripening of the fungus spores. Frequently whole cheeses are fairly uniformly covered with this mold in a few days. After the first two weeks the mold ceases to grow actively on the surface. The delicate fibrous mycelium is largely torn away later by the handling of the cheese in the cellar. The places so exposed become centers for rich developments of bacteria and *Oidium lactis* in reddish-brown areas, which sometimes entirely cover and obliterate the penicillium. The rind may then vary from a surface comparatively dry, moldy and gray, through every stage to entirely viscid, slimy and red or reddish-yellow, with scarcely a visible trace of mold. Internally, at first, the cheese should be a fairly firm, homogeneous mass of curd soured in one or two days by lactic organisms; then a digestion and softening of this curd, beginning just under the rind, should gradually progress inward until the entire mass is changed. The extent of this change is readily visible, so that in a cut cheese the exact stage of ripening is at once apparent. The texture of the resulting ripe cheese varies exceedingly with the conditions. In certain brands of Camembert imported to America, wrapped in tinfoil, the interior, when ripe, is so soft that when cut the entire mass flows out of the rind as a liquid. In other brands, and, so far as seen, universally in France, the cheese is so ripened that the texture is waxy or buttery soft, to be spread easily on bread with a knife, but solid enough never to 'run,' never liquid. The very soft brands nearly always have very high flavor, even sharp and biting. The waxy brands are much milder, not so intense, and with less odor." (U. S. Dept. Agric., Report of the Bureau of Animal Ind., 1905, p. 82.)

In Camembert cheese-making, a very firm curd is secured from cow's milk in one and one-half hours. The hoops, four and one-fourth inches in diameter and five inches in height, are set closely on mats covering the draining tables. The curd is dipped into the hoops with long-handled dippers. The greatest care is taken to break the curd as little as possible. Two quarts of curd are required to fill each hoop, making nearly one-half pound of fresh cheese. Cheeses so made are allowed to drain very slowly without pressure. When sufficiently firm to handle, they are salted by sprinkling them with, or rolling them in, coarse salt, allowed to drain once more, then placed in the ripening-room, where they obtain their moldy rind. This mold may be inoculated on the cheese by the maker, or, in the presence of many well-molded cheeses, will propagate itself with ample rapidity to accomplish the same end. The ripening-rooms are best maintained at a temperature of 54° to 58° Fahr., with fairly moist atmosphere. Placed on shelves in such a room and turned repeatedly, such cheeses should ripen in four to six weeks, according to the temperature and the water-content of the cheese.

Camembert cheese-making in France is practiced throughout the region of Normandy from Caen to Rouen, and in many places east of Paris. Some Camembert is also made in parts of Germany. Whole milk, or milk from which less than one-half per cent of fat has been removed, is used for this cheese in France. In Germany, skimmed milk, or partly skimmed milk, is used, and produces a much lower grade of cheese. Some German Camembert is imported in tins.

Brie cheese is made in the districts east of Paris, Brie, Seine et Marne, and elsewhere. Both Brie and Camembert are used in enormous quantities in France.

Coulommier.—Coulommier is closely similar to Camembert and Brie cheeses. It is made in the districts of France, north and east of Paris. It differs from Camembert in the larger diameter of the cheese (between Camembert and Brie in size) and in the absence of salt. It has been imported on a very small scale into New York city only.

Cheese ripened mainly by bacteria.

Brick-cheese (John W. Decker).—Brick-cheese is made mostly in Wisconsin. It gets its name from being pressed into "bricks" under weight of one or two bricks. A Brick-cheese weighs five or six pounds. It is made from sweet milk, coagulated by rennet, cut with curd knives and heated in the whey to firm it. The temperature to which it is heated depends on the acidity of the milk, since acid hastens the expulsion of the whey. Very sweet curd must be heated to 118° or 120° Fahr., while riper curds can be firmed at lower temperatures. Brick-cheese should be made from curd showing no strings on the hot iron before pressing, but enough acid for firming easily is desirable. If it feels firm when squeezed in the hand, nearly all the whey is drawn off, and the curd is dipped into wooden molds placed on a draining-table. These molds are 5 x 10 inches in size, and without bottoms. The draining-table is covered with draining-boards with holes in them, and they are raised half of an inch above the table. A linen strainer-cloth covers these boards. The wooden molds are set close together on the cloth. The curd is filled into them, and the whey drains out while the curd settles together. A wooden follower is placed on top of the curd and a brick put on for weight. The cheese is pressed in this way for twenty-four hours, then goes to the salting-table where it is rubbed with salt. After two to four days of salting it goes to the curing-cellar where it is rubbed and washed and turned one to three or four times a week. At the end of a month it is ready to ship. Each brick is wrapped in a manila paper and packed in a box holding a little over one-hundred pounds of cheese.

Plate V. A modern sanitary dairy stable

The cheese is mild in flavor and of moderately close texture. The milk from which it is made must be of fine quality, as gassy fermentations will spoil it. It is easily made and the equipment necessary is simple. It is best cured in cellars where the temperature and moisture can be regulated.

Limburger cheese (John W. Decker) -- Limburger cheese is made much like Brick-cheese. The difference is in the extremely moist conditions in which it is cured, and which cause a characteristic fermentation.

It is coagulated with rennet, the curd cut as in Brick-cheese, but the firming temperature is lower, about 95–98° Fahr. The curd is put into molds like those for Brick-cheese, which are 5 x 20 inches. The follower and brick pressure are omitted. When the curd has settled together into a solid cake, the mold is removed and the cake cut into four blocks five inches square. These blocks are then removed to a draining-table, where each two cheeses are separated by wooden partitions to prevent spreading. After draining and cooling for twenty-four hours, the blocks are salted, as is Brick-cheese, by rubbing, on several different days, with salt. After salting, the blocks are removed to the shelves, where they are dipped in water each day and kept under very moist conditions. In a few days a reddish yellow mold begins to grow on the surface, and the hard, white curd softens and turns yellow. In the course of a month the change works to the center of the block. Each block is wrapped in manila paper and then in tinfoil, and packed in a box 5 x 20 x 36 inches, for shipping.

Limburger cheese is popularly known by its odor, but this odor is not prominent in the curing-cellar. The odor is developed by higher temperatures. Limburger cheese is largely made in Wisconsin by German makers.

Fromage d' Isigny, Fromage de Brie (domestic).-- Numerous factories in New York, Michigan, Iowa and Wisconsin produce a type of cheese variously labeled as Fromage d' Isigny, or Fromage de Brie, or even both names combined on a single label. Perhaps the name "Isigny" alone would best designate this style of cheese, which is said to have originated in New York state as far back as 1866. Although bearing the name of a French town and resembling several styles of French cheese, such as Pont l' Eveque and Livarot especially, Isigny may be called an American product or adaptation, at least.

An Isigny cheese is made about one and one-fourth inches in thickness and five inches in diameter. Different brands vary from skimmed milk to whole milk cheese. In manufacture, a hard curd is made, as for Camembert cheese, dipped into hoops about five inches in height and permitted to drain without pressure. The resulting cheese should consist of smooth, close-grained curd. It is rolled in coarse salt. allowed to drain and then placed in a ripening room or cellar at, or nearly at, 60° Fahr. In this cellar the cheese is washed from time to time. Colonies of mold are scraped from the surface. It is ripened by the agency of various species of surface bacteria and *Oidium lactis*, which is always present to some extent. In a period of three to five weeks, Isigny becomes partially or sometimes completely softened, almost buttery, acquiring at the same time a pronounced odor and characteristic strong flavor. Exactly the same process has been used in making and ripening the cheeses labeled *Fromage de Brie*. These are made merely with a larger diameter and are often colored more deeply. Practice differs in different factories. One brand is commonly ripened for a longer time than the other. Such differences as appear are differences in the stage of ripening and intensity of flavors produced, not in the character of ripening or flavor. It must not be confounded with the French Brie.

The same cheese, made four and one-fourth inches in diameter, with its ripening completed in little wooden boxes, has been labeled Camembert in certain factories. The use of the names Camembert and Brie for cheeses of this type is unwarranted by any character except the size and shape of the package. The use of the name "d'Isigny" is the arbitrary appropriation of a French name without significance.

Exactly the same cheeses in different sizes and shapes are labeled *lunch*, *miniature*, and other names.

Unripened Isigny.—In addition to the ripened Isigny, there is a large trade in unripened Isigny. These cheeses are commonly made from separated, or partly separated milk, curdled and drained in the same way as the other, but shipped at once to the market. Such products are said to go mostly to the Jewish trade, since they conform to the requirements of the Mosaic law, and are, therefore, "Kosher" or "clean." They combine the cheapness of skimmed milk with high proteid content, hence form an economical, though not especially attractive form of nitrogenous food.

Port du Salut. Port du Salut is a cow's milk cheese, imported to some extent from Normandy. The same type of cheese is made by the Trappist Fathers, near Montreal, with much success.

Port du Salut is a cheese of smooth, fairly firm texture, made in discs one and one-half to two inches in thickness and eight to twelve inches in diameter, ripened with a thin, yellowish or colored but smooth rind, showing *Oidium lactis* and bacteria. With the same odor as d'Isigny, it has a mild flavor that is much praised where well known.

Pont l'Eveque is but little imported, and only to New York city. No attempt has been made to introduce its making. It appears as cheeses almost square (three to four inches), with rounded corners, and one inch or less in thickness. The milk used in making it is partly skimmed and curdled at 34° to 35° C. The curd is kneaded with the hands and the cheeses are ripened, by the action of the bacteria and *Oidium lactis*, to a semi-solid, smooth texture and very fine flavor. Such varieties offer large possibilities in the disposal of partly skimmed milk.

German breakfast cheeses.-- The brands of ripened cheese made from milk which is partly skimmed, or even separated, are multiplying. Most of these bear German names and appeal to communities of German descent. They appear in numerous styles

of package, as the biscuit-shaped "hand" cheeses, well-sprinkled with caraway seeds, which resemble the Hartz Kæse; the disc-shaped Sierra cheese; the rectangular forms, Romatur and Frühstück Kæse, bearing their well-known continental names. The different makes vary widely in the fat test of the milk used, in the shape and style of the package,

Fig. 233. A tasteful dairy building or factory. (Dairy-farm of J. N. Givens, Aiken, S. C.)

and the extent of ripening. Their ripening is due to bacteria and *Oidium lactis*, and is commonly associated with strong odors resembling Limburger. Except the German communities, especially in the larger cities, the market for such cheeses has been strictly limited, and many forms of them are made on the farm for purely local use.

Ripened Cottage cheese.—Among the German communities in Pennsylvania, a ripened Cottage cheese is made on the farm. In this the milk is allowed to curdle by souring, is thoroughly drained, then set away to ripen for several days, and stirred frequently. When ripened to taste, the vessel is placed in boiling water and the curd melted. Cream and butter are added, to the taste of the maker. Some cheeses produced in this way suggest Camembert in texture and flavor. Although this may be very acceptable for home use, the practice does not admit of factory extension without practically changing the product.

Other soft cheeses.

Other varieties and brands of soft cheese, as Lancashire and Wensleydale, are found in the markets, but in limited amounts. It seems probable that with the standardization resulting from better factory organization and wider general acquaintance with the really choice varieties, the number of kinds of soft cheese manufactured will not increase rapidly, but the best kinds will be better made and handled. A critical review of actual products indicates that among the hundreds of described kinds of cheese very many are little more than local trade names for minor differences of manipulation, or merely for differences in size or shape of package, and do not represent real differences in the product. With the enlargement of production and market, trade names will multiply exceedingly, but the less attractive styles of whole-milk cheese can not compete with the better ones, such as Roquefort, Camembert, Domestic Neufchâtel and Cream. A greatly increased market, however, may be anticipated for the better grades of skimmed-milk cheese, which are a source of proteid food, whose value hitherto has been very little appreciated in America.

Literature.

In addition to the references given on page 219, the reader should consult the following: Charles Thom, Fungi in Cheese Ripening, United States Department of Agriculture, Bureau of Animal Industry, Bulletin No. 82; Charles Thom, Soft Cheese Studies in Europe, same, Report, 1905. Current dairy texts may also be consulted.

CREAMERIES AND SKIMMING STATIONS

By *H. L. Ayres*

A creamery is a building equipped for receiving and skimming milk, ripening and churning cream, and working and packing or printing butter. The term is sometimes applied to plants which sell milk, cream, butter, baker's cheese and Cottage cheese. Gathered-cream creameries receive and manufacture the cream that has been separated on the farms.

Importance of the creamery.

The creamery ranks high in the agricultural economy. Sections in which dairying prevails are noticeable for their prosperous condition. The manufacture of butter is centralized by the creamery and a more uniform product is secured. Each patron has the record of the amount of milk produced, and its value and test, thereby stimulating competition in the breeding of better cattle and the production of more and richer milk. The highest prices are secured, and the patrons are given their money regularly. A center of interest is also formed in communities. In encouraging and enlarging dairying, the fertility of the farms is improved by returning to the land much of the product of the land in the form of manure. Considerable money is realized by feeding to calves and pigs the skimmed milk that is returned; authorities place the feeding-value of skimmed milk at fifteen to twenty-five cents per hundred pounds.

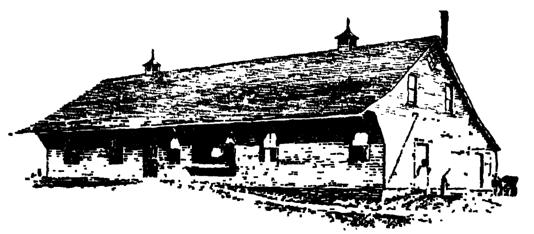


Fig. 234. A creamery building in Ontario.

Location of the creamery.

To insure success, a creamery needs to be assured of the milk of at least three hundred cows. The

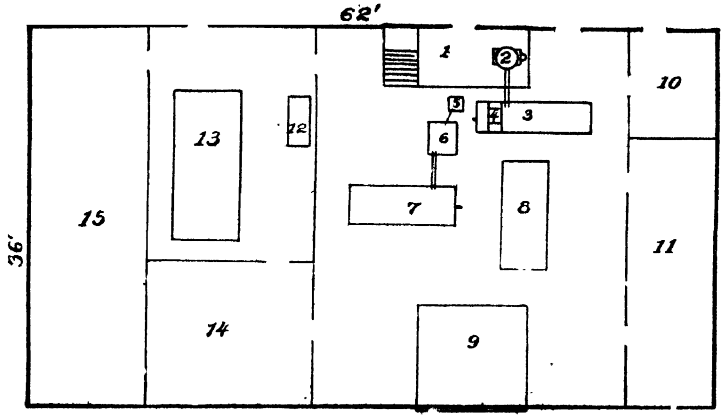


Fig. 235. **Floor plan of a creamery.** 1, Receiving platform; 2, weighing-can and scales; 3, receiving-vat; 4, milk heater and pump; 5, separator; 6, pasteurizer, 7, cream-vat, 8, combined churn and worker; 9, refrigerator; 10, office, 11, storeroom, 12, engine, 13, boiler; 14, shop; 15, coal-room.

building should be placed where it will be convenient for the largest number of patrons, but, if necessary, this may be sacrificed for a location where a large supply of pure water - at least thirty barrels daily, and more if possible—and good drainage can be secured. Ice should also be secured readily, unless mechanical refrigeration is used. The ideal water-supply is from springs located sufficiently above the creamery to force the water through the building without pumping. When protected against surface water and other contamination, wells are satisfactory if the supply of water is sufficient. A spring-water stream also furnishes good water if a well or reservoir is dug a few feet from the stream so that the water is filtered

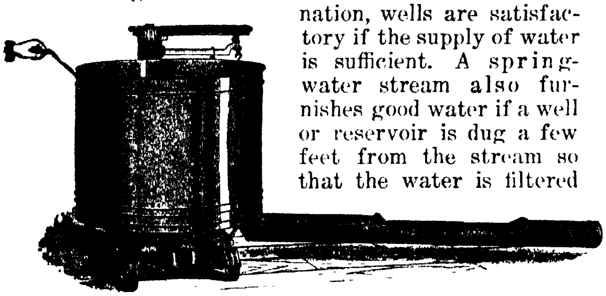


Fig. 236. Weighing- or receiving-can.

in passing through the soil, and the water pumped from this reservoir.

Drainage may be into a stream, on a field, or through a septic tank. If a septic tank is used, the clear water may be discharged elsewhere and only milky water run into the tank. Experiments have shown that the tank should hold ten day's sewage; or ten small tanks might better be used, each holding a day's sewage. The purpose of the septic tank is to hold the sewage until fermentation reduces the soluble part of the solid matter to liquid form. This is accomplished by having a double tank. The first tank is called the receiving- or settling-tank. When the sewage in it rises to the height of the outlet connecting with the second tank, a few inches of the liquid is drawn from the top through an automatic siphon. The second tank is also fitted with a siphon discharge, this latter outlet being continued with glazed tile to the point where it is desired to dispose of the water. At this point the unglazed tile should be used and laid without cement, with joints open three-eighths of an inch. These latter tile may branch in various directions and need be only three-inch. Horse-shoe tile may also be used. With either, the joints should be covered with a loose-fitting cap to permit the distribution of the liquid through the soil. A manhole should be constructed at the top of each tank for the purpose of cleaning. Cement is the most satisfactory material for the tanks. The laws are very strict regarding the emptying of sewage into creeks, lakes and rivers, when the water is used for household purposes, and the health commission should be consulted if there is any doubt. It is an advantage to have the building shaded.

If the gravity system is used in receiving milk, the creamery should be built on a hillside, so that milk can be received on the high side. If the pumping system is used, it should be built on level ground. The gravity system is that which receives the milk on a higher level than the work-room, causing the milk to flow from the receiving-can, in which it is weighed, to the receiving-vat, where it is stored. From this vat it flows through the heater to the separator on a lower level. Leaving the separator, the skimmed milk flows into a tank from which the patrons draw their shares. The cream from the separator flows into cream-vats on the same level. The churn is on a lower level, so that the cream will flow from the vats to the churn. In the pumping system the receiving platform is elevated to allow the milk to flow from the receiving-can to the receiving-vat, all the other work being done on one level and pumps used for elevating the milk to the heater, the skimmed milk to a storage-tank, and the cream into the churn. The

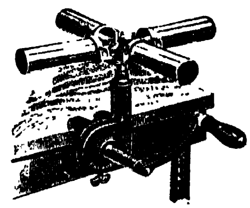


Fig. 237. Simple milk-tester, for few samples. Adapted for home use.

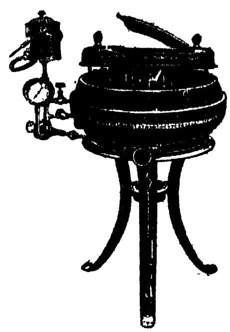


Fig. 238. Turbine milk-tester with stand.

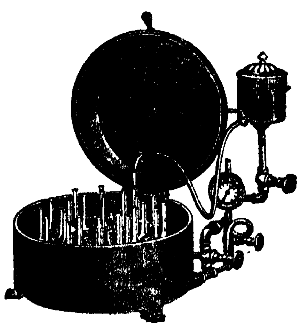


Fig. 239. Steam Babcock tester.

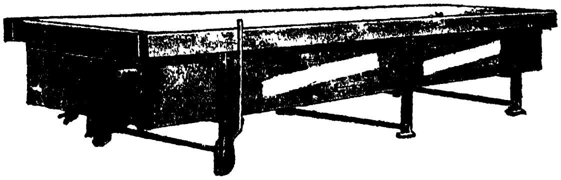


Fig. 240. Milk- or cream-vat.

skimmed-milk tank is usually placed in the attic, and the milk drawn through an automatic weigher by the insertion of a proper-sized check, given the patron by the operator.

Construction.

The construction of a creamery has much to do with the cost of maintaining and operating it. The building should be convenient, warm, and well ventilated. It should have seven rooms, namely: Work-room, office, refrigerator, boiler- and engine-room, store-room, workshop, bath- and laundry-room. In Fig. 235 is shown a floor plan of a creamery differing slightly from this arrangement. In place of the bath- and laundry-room a coal-room is shown.

The ground should be excavated to a firm foundation for the walls and floor. The walls should be of concrete, plastered smooth with portland cement. The walls are better if built hollow. They should extend three feet above the floor.

The floor should be laid with four inches of concrete, made of four parts of gravel, two parts sand and one part portland cement. Before this sets, the finish coat, made of two parts clean, sharp sand and one part of portland cement, should be laid one inch thick on top of the concrete, and made smooth as it is setting. The floor should slope one inch in three feet toward a gutter running through the center of the floor and discharging into a six- or eight-inch tile drain through a trap. A basin twenty inches square should be formed around the entrance of the drain, into which the gutter may discharge. The gutter should be six inches wide, very shallow at the beginning and gradually deepening to the point of discharge. The corners where the floor and walls meet should be rounded, and all other corners of cement, such as of walls and steps, should be neatly rounded.

The receiving platform and steps are best made of cement. The remainder of the building above the walls may be of frame structure, but cement is very desirable for the entire building. Smooth, plain doors, and the absence of all ledges, window-sills, and other projections are desirable, so as to have as few places as possible to catch dust.

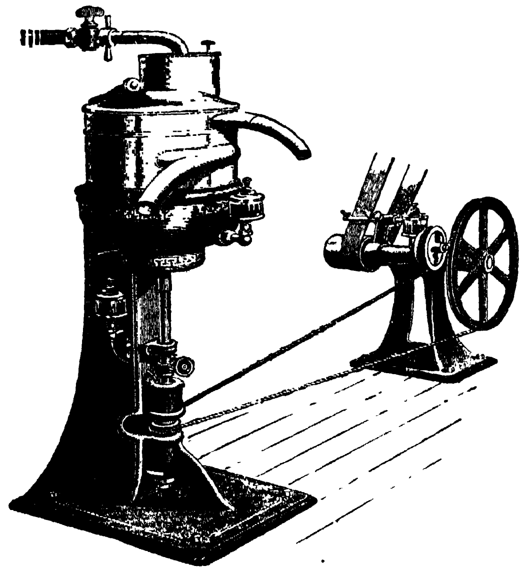
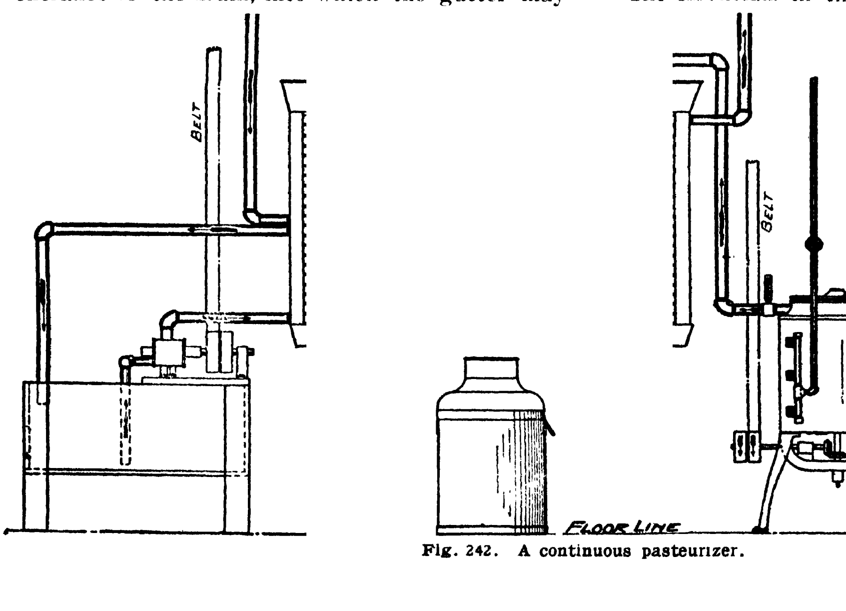


Fig. 241. A type of power separator.

Equipment and its use.

The essentials in the equipment of a creamery are, receiving-can, scales, milk-receiving vat, cream-vat, milk-heater, separator, skimmed-milk tank, skimmed-milk weigher, combined churn and worker, Babcock tester, boiler, engine, milk-pumps, water-pump sterilizer, and the necessary tinware, glass-



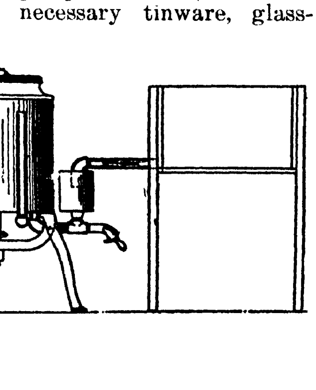


Fig. 242. A continuous pasteurizer.

ware, and small utensils. A pasteurizer may be added, if desired.

The receiving-can may be round or square, about thirty inches high by thirty to forty inches in diameter, with a three-inch faucet or gate at the bottom. (Fig. 236.) This is used on the scales for receiving and weighing the milk. The weight is recorded. The samples of the milk, taken as it is received, are put in glass stoppered bottles, which contain preservatives, usually corrosive sublimate, with a coloring matter to warn against their use greatly increasing the relative difference in the specific gravities of the milk and the cream, therefore the immediate and complete separation. [See page 199.] Leaving the separator, the cream is conducted to a pasteurizer, if it is desired to pasteurize the cream (Figs. 242, 243); if not, it goes directly to cream-vats or a cream ripener. (Fig. 244.) The latter is a vat fitted with mechanical means of agitating and controlling the temperature of the cream. In the vats or ripeners, the cream is held at 68° to 75° Fahr., and 5 to 25 per

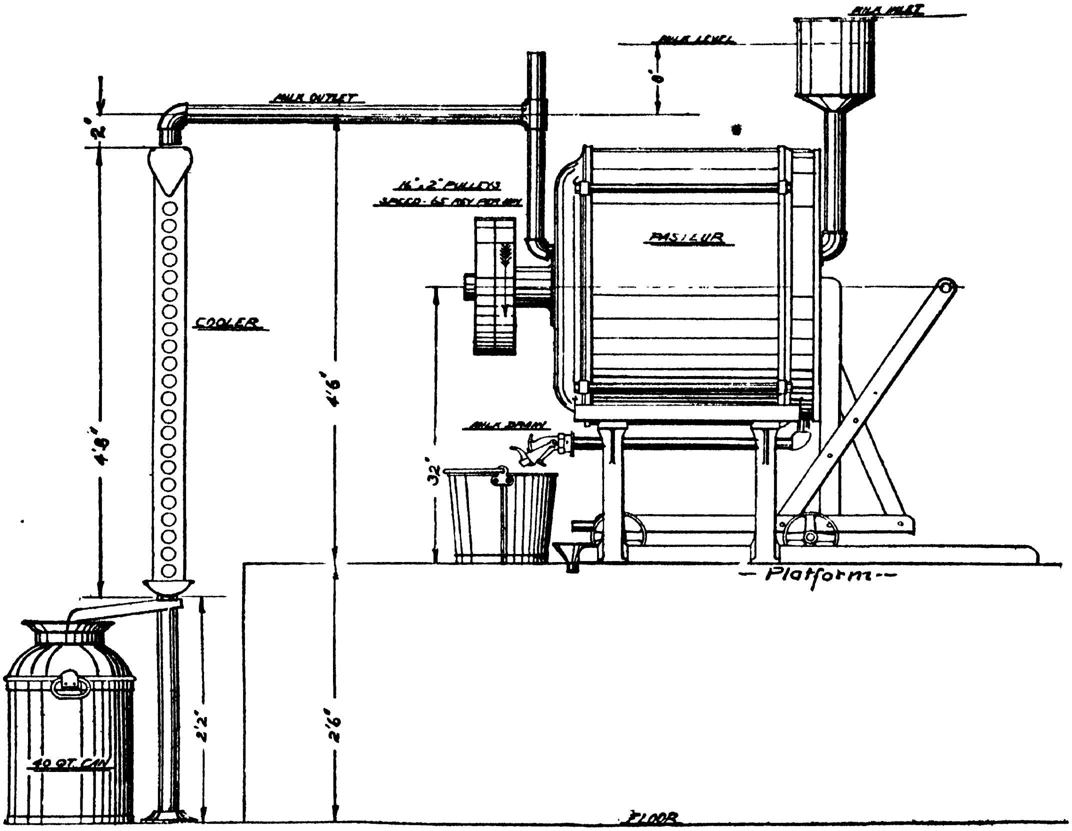


Fig. 243. A regenerative pasteurizer, showing principal dimensions for installing.

as food: or bichromate of potash may be used. Usually composite samples are tested at the middle and end of each month. Testing machines are shown in Figs. 237-239.

From the receiving-can, the milk is conducted to the receiving-vat, which is an oblong tin vat with either a flat or rounding bottom, and a faucet at its lower end. The vat may be either skeleton or enclosed in a wooden jacket. (Fig. 240.)

From the receiving-vat the milk runs or is pumped through a heater, which raises the temperature to 85° to 90° Fahr. This aids in complete separation. The milk next passes into the separator. (Fig. 241.) A separator consists of a frame fitted with delicate bearings, in which a steel bowl revolves at a speed of 6,000 to 14,000 revolutions per minute. The high speed has the effect of cent of pure culture starter is added. This treatment develops lactic acid, and flavors desired in eight to twelve hours. The temperature is then quickly lowered to 50° to 54° Fahr., and held there for three to twelve hours. The cream is then transferred to the churn or combined churn and worker. (Fig. 245.)

The churn consists of a large wooden cylinder or box with tightly fitting doors, containing shelves or other devices to increase the concussion of the cream, and having a suitable gearing to revolve it. The combined machines have corrugated wooden rollers or something similar in effect, which are brought into use, causing the butter to be worked before removing from the churn. The buttermilk is then drawn off, and the butter washed and salt added. Working thoroughly incorporates the salt,

and gathers the butter in a mass, making it ready to be packed in tubs or printed.

Any kind of steady power may be used. A fifteen or twenty horse-power boiler with an eight horse-power engine is very satisfactory. Water-wheels, electric-motors and gasoline-engines may be used. Gasoline is objectionable because of the strong odor, which taints the butter if it comes in contact with the milk, cream or butter.

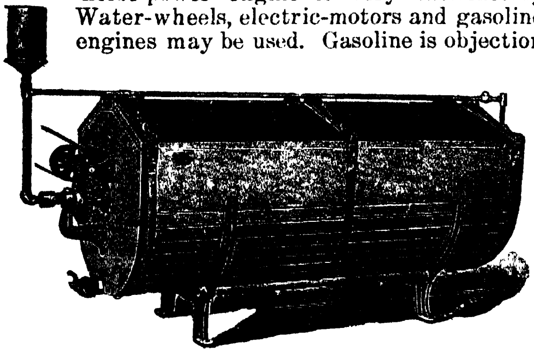


Fig. 244. A cream ripener

The pipes conducting steam and water should be of ample size and jacketed with coverings to decrease condensation and change of temperature. All valves should be of a kind that are quickly and easily repaired without removing from the pipe lines.

Organization.

Creameries may be proprietary, joint stock company, or coöperative. In the first, the owner usually buys the milk and returns the skimmed milk, in other instances buying the whole milk and making the skimmed milk into cheese—Cottage or baker's cheese,—or casein. Sometimes the same price is paid for all qualities of milk, but usually the milk is tested and the fat contained in the milk is paid for. This is the more just way. The butter may also be made and sold for a certain price per pound.

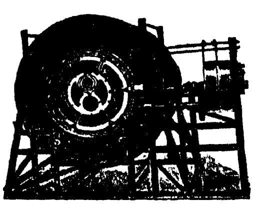


Fig. 245. A churn with worker attachment.

A joint stock company may buy the milk or make the butter in either of the above ways.

The coöperative creamery is owned by the farmers who bring the milk. It is an association which has adopted certain by-laws, and elects officers or directors—usually five or seven in number—to conduct the business. The board of directors elect from their number a president, vice-president, secretary, treasurer and manager. In some instances, the board is allowed to elect officers outside of their number, but stockholders in the association. These officers have the care of the property, hire the butter-maker, secure the supplies, sell the products, compute the monthly payments for milk, and pay the patrons. The coöperative method of payment is to deduct all expenses from all money received for products, and divide the remainder by the pounds of fat furnished by the patrons. This gives the price per pound of fat. The weight of each patron's milk is multiplied by the test to obtain the number of pounds furnished by the patrons. This result is multiplied by the price per pound of fat, to determine the amount due each patron. The more butter made the less the cost per pound for making.

If a creamery pays for pounds of fat, the price per pound will be higher than if it pays for pounds of butter, for the same amount of money is divided by a less number of pounds. Sometimes the expenses of the creamery are deducted and the remainder divided by the pounds of fat or butter in order to arrive at the price.

In most places the amount of milk produced at different seasons of the year is so varied that it causes the cost of making a pound of butter to vary so much that it is usually advisable for the association to make butter for a stated price per pound, and once a year to declare a dividend to the stockholders, pro rata, on the amount of stock owned. Once a year a stockholders' meeting is held, when the officers report on the finances and directors are elected for the ensuing year.

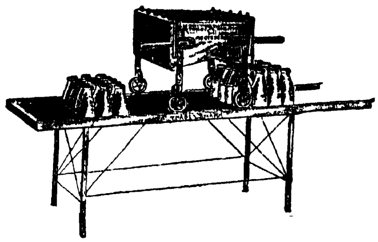


Fig. 246. Side-bar milk-bottle filler.

The first item in the management of a creamery is to secure the milk. The marketing is equally important. Regularity in the time of paying patrons, proportionate distribution of skimmed milk, a diplomatic maker, careful buying and constant guarding against leaks and losses, all go to make a successful creamery.

Gathered-cream creameries and centralizers.

In parts of the West-Central states the farm separator and the gathered-cream creamery have superseded the whole-milk creamery almost entirely, and there is little likelihood of the latter ever coming back into use. There has also been developed in the same section, within recent years, a class of creameries that are called centralizers. These are

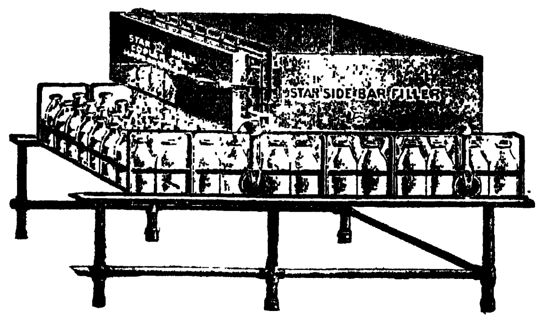


Fig. 247. Sanitary milk-bottle filler.

now an important factor in the development of the dairy industry in these states. These factories are located, not in the small towns, but in the large cities. Their cream supply is received entirely by rail, and in some cases is shipped two or three hundred miles. This cream either is shipped directly from the producer, or, when a supply in a given locality is larger, the company has an agent who receives the cream, pays for it, and forwards it to the factory. A considerable part of the butter now manufactured in Kansas, Nebraska, South Dakota and Missouri, is made in such plants, and they are also doing a large business in the better developed creamery states, such as Iowa, Minnesota and Wisconsin.

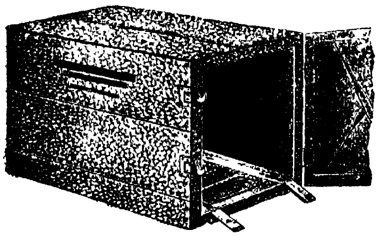


Fig. 248. Galvanized iron sterilizers for creamery use.

This practice has the advantage of giving the dairyman the skimmed milk for feeding while it is fresh and sweet, and not mixed with other milk, as it would be at the creamery. It makes the amount to haul much less. No time is lost at the creamery waiting for skimmed milk, and the creamery is saved the handling of the skimmed milk. There are also disadvantages with this system. The care of the separator makes extra work. In many cases considerable fat is left in the skimmed milk by farmers who are not trained in the use of separators. There is a tendency to hold the cream for two or more days instead of delivering it every day, which results in butter of poorer quality. Milk will hold over better than cream.

In the larger centralizing plants, and in some of the smaller ones, too, the cream is graded and paid for according to grade. If each producer could carry a good clean starter, and add 5 per cent to the fresh cream, it would check many of the undesirable germs and flavors that grow in the cream while it is held for delivery. The cream from skimming stations handled in this way reaches the central plant in much better condition.

Skimming stations.

Skimming stations are equipped much the same as creameries, except they do not have ripening-vats, churns or butter-workers, the cream being taken to the creamery to be ripened and churned and the butter finished. The purpose of a skimming station is to collect milk that is produced at too great a distance to be delivered at the creamery. The cost of equipping and running a station is considerably less than for a creamery. A more uniform product is secured by being all finished in one plant. A skimming establishment is an intermediate station between the farm and the creamery.

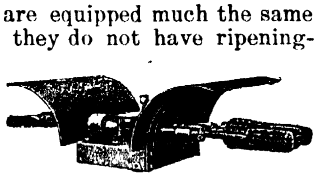


Fig. 249. A power bottle-washer.

Cost of building and equipping creameries and skimming stations.

The amount necessary to invest in a creamery varies with the requirements. An ordinary creamery at the present time costs $3,000 to $6,000 for building and equipment. For a creamery costing $3,000, the cost would be divided about as follows :

Building, including ice-house, refrigerator, etc.	$1,300 00
Boiler	600 00
Engine	125 00
Separator	300 00
Churn	200 00
Vats	150 00
Milk heater	50 00
Pumps	60 00
Scales	40 00
Shafting, pulleys and belts	75 00
Pipe and valves	50 00
Tester	25 00
Small utensils	25 00

The value of a $6,000 plant would be divided about as follows :

Building, including ice-house, refrigerator, etc.	$2,600 00
Boiler	900 00
Engine	200 00
Two separators	1,000 00
Churn	250 00
Cream ripener	400 00
Milk heater	80 00
Pumps	60 00
Scales	40 00
Shafting, pulleys, and belts	100 00
Pipe and valves	100 00
Tester	30 00
Vats	90 00
Automatic skimmed milk weigher	100 00
Small utensils	50 00

These estimates do not include site, water-supply and drainage. The $6,000-plant might have a less expensive building, and no ice-house, but substitute artificial refrigeration. This would be desirable in localities where ice is expensive or uncertain. The $3,000-creamery is suitable to handle the milk of 400 to 600 cows; by adding another separator, the milk from twice that number of cows could be handled, but two churnings of butter per day would be necessary. The $6,000-plant could handle the milk of 800 to 2,000 cows, but, for the latter amount, another cream ripener or cream vat would need to be added.

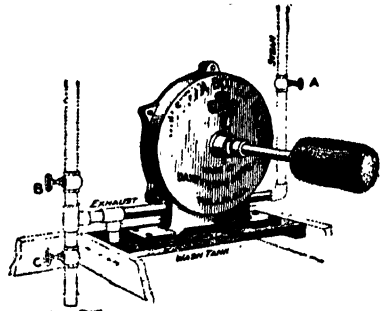


Fig. 250. Steam turbine bottle-washer.

As a skimming station requires a much smaller building, and only part of the machinery necessary for a creamery, its cost is much less. From $300 to $600 might be invested in the building, and $700 to $900 in the machinery.

Literature.

McKay and Larsen, Principles and Practice of Butter-Making ; H. H. Wing, Milk and Its Products; Russell, Outlines of Dairy Bacteriology; Farrington and Woll, Testing Milk and Its Products ; Van Slyke, Modern Methods of TestingMilk. [See *Butter-making*, page 198.]

REFRIGERATION OF DAIRY PRODUCTS

By *Oscar Erf*

It has been conservatively estimated that 25 per cent of the original value of dairy products on the farm is lost by deterioration due to the lack of proper refrigeration. Dairying has become one of the chief industries of the United States, hence it is essential that proper refrigeration be applied to this industry.

Refrigeration of dairy products may be classed under three heads, namely : (1) Refrigeration on the farm ; (2) Refrigeration in dairy manufacturing concerns, as, for example, creameries, cheese factories, milk-distributing plants, ice-cream factories, and the like ; (3) Refrigeration in cold-storage plants.

I. *Refrigeration on the farm.* [See page 241.]

Refrigeration on the farm includes the cooling of milk and cream, and, when made on the farm, of butter also. For average farm conditions the only practical method of refrigeration is by means of natural ice, which has been harvested in winter from lakes, ponds or streams and stored in ice-houses for summer use. This is practicable only in places in a latitude where ice freezes in winter to such a thickness and with such certainty as to make its harvesting profitable. Such a latitude depends somewhat on the altitude and location with respect to large bodies of water. The southern limit in eastern and central parts of the United States is about 38° N. On the shores of the Pacific ocean conditions are not favorable for harvesting ice south of parallel 49° N. However, in this particular country, snow-capped mountains lying close to the shore furnish an abundance of cold water, the temperature of which will preserve dairy products to a great extent. When the harvesting of ice is practiced, economical refrigeration can be applied on farms of any size by means of storing ice in ice-houses.

A different problem confronts the farmer in the South, where the temperature is seldom low enough to freeze water. This problem can be solved conveniently by erecting artificial ice-plants in connection with the creamery plants, thus producing ice for farmers to cool their milk or cream. The ice is delivered to the farmer by the creamery or milk wagon. This wagon makes a circuit daily or every other day, delivers the cream or milk to the creamery, returns with the empty cans and delivers the ice. This is impracticable in countries that are sparsely settled and where the ice must be delivered long distances. Well-insulated refrigerators and cooling-tanks are very necessary where this system is in vogue.

(a) *Farm ice-houses.*

It is essential that northern farmers should provide themselves with a properly constructed ice-house that will preserve the ice, so as to allow the cooling of dairy products throughout the warm season of the year. In building ice-houses there are two conditions to be considered : First, the cost of the ice in the ice-house in winter ; second, the cost of constructing the ice-house. In localities where the harvesting of ice is expensive, it is advisable to spend more money in well-constructed and insulated ice-houses. In localities where ice is comparatively inexpensive and can be secured in abundance, it would be more economical to build a cheaper but larger structure, and harvest a greater quantity of ice. This is true when ice-houses are located on the shores of large streams or lakes where it is not necessary to transport the ice. The hauling and transporting of ice is the most expensive part of the ice-harvesting business.

The size of an ice-house in relation to cost.—The larger the volume of ice to be stored, the cheaper will be the cost of constructing an ice-house per ton of ice stored, providing it has the proper dimensions. Theoretically, the best form for an ice-house is spherical, because it has the least possible number of square feet of surface in proportion to its volume. The heat can penetrate only through the outer surface ; hence, the smaller the outer surface in porportion to the volume the better the construction. The next best form for an ice-house would be cylindrical. The best practical ice-house for small farms, however, is built in the form of a

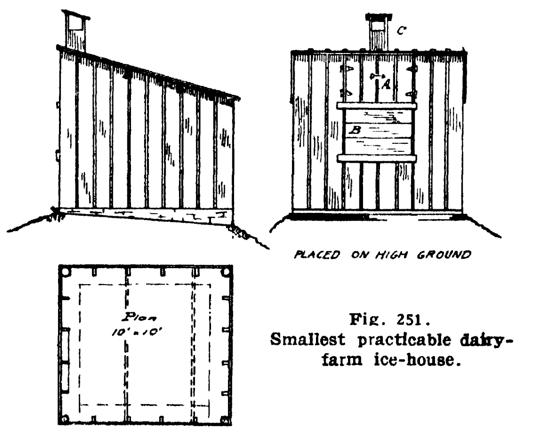


Fig. 251.
Smallest practicable dairy-farm ice-house.

cube. The smallest practical dimensions for a dairy-farm ice-house are 10 x 10 x 10 (Fig. 251). The greater the increase of these dimensions, the more economical the house will become in proportion to the amount of ice it will contain. With a fixed

volume, the nearer the form of a cube an ice-house approaches, the less surface it will have.

The cost of insulation is usually figured by the square feet of wall surface. The top and bottom of an ice-house, if properly constructed, cost proportionately the same as the walls with insulation; hence, it is practical to estimate the cost of such an ice-house by the square feet of surface in the

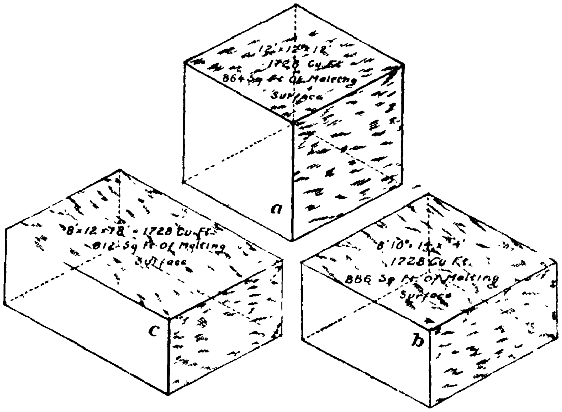


Fig. 252. To show differences in surface areas for same volume in different forms.

cube. The following illustration demonstrates the economy of building an ice-house of the greatest capacity needed for a particular place:

An ice-house 10 feet long, 10 feet wide, and 10 feet high contains 1,000 cubic feet. A cubic foot of ice weighs 57 pounds; if well piled in an ice-house, it is estimated that it will weigh on an average of 40 pounds per cubic foot; hence, in an ice-house 10 x 10 x 10, containing 1,000 cubic feet, there would be 40,000 pounds of ice, or 20 tons. There being six sides to a cube, there is required 600 square feet of insulation, which, at 10 cents per square foot, would cost $60. Assuming that the ice-house is increased in size to 12 x 12 x 12, containing 1,728 cubic feet, it would contain 69,120 pounds of ice, or approximately 34½ tons. This ice-house has 864 square feet of insulating surface, which, at 10 cents per square foot, would cost $86.40. If the ice-house be increased to 15 x 15 x 15, it would hold 135,000 pounds of ice, or approximately 67½ tons. Such a structure would have 1,350 square feet of insulating surface, which, at 10 cents per square foot, would cost $135. The ratio of the volume to the cost of construction would be as follows: For the ice-house 10 x 10 x 10 the construction costs $3 per ton; for the ice-house 12 x 12 x 12 the construction costs $2.50; for the ice-house 15 x 15 x 15 the cost per ton would be $2. The ratio decreases proportionately as the size increases.

Relation of cost to volume in different forms.—(Fig. 252.) Assuming that an ice-house, instead of being built in the form of a cube, is constructed 14 x 14 x 8 feet 10 inches, this having approximately the same volume as the one 12 x 12 x 12, the number of square feet of surface on this form would be 886, while the number of square feet of surface on the one built in the form of a cube is 864. There would be a difference of 22 square feet, which would allow the meltage of that much more ice, and it would cost $2.20 more for construction. However, this form is used in large ice-houses, over 60 x 100 feet, it being impracticable to hoist the ice very high in order to form a cube to prevent meltage.

An ice-house built in the form of a parallelopiped, 18 x 12 x 8, would have 912 square feet of surface to the same volume as the cube 12 x 12 x 12, or 48 square feet more than the surface of the cube, costing $1.80 more for construction. Consequently, the best and cheapest form is to build an ice-house as nearly a cube as is practicable.

The location of an ice-house.—An ice-house should be located in a convenient place so as to avoid the transportation of ice any great distance. It is best to have it near or in connection with a storage-house. The house should be built on dry ground, and, if possible, on a high place. Ice-houses are sometimes built in connection with residences. While this is a great convenience, if the ice is to be used in the house, it is not advisable, for ice is always more or less damp and, naturally, increases the humidity of the air in the house. If it is to be built close to a house it is better practice to have an open space between the ice-house and the residence, or have a cold-storage room or a storeroom connecting the two.

Underground versus surface ice-houses.—The first ice-houses were built below the surface of the ground (Fig. 253), but, owing to the great amount of meltage in such structures, they have been abandoned and at present are being constructed above the ground. This affords better drainage, is more convenient for securing ice during the summer, and prevents an excessive loss of ice because of the earth being such a good conductor of heat.

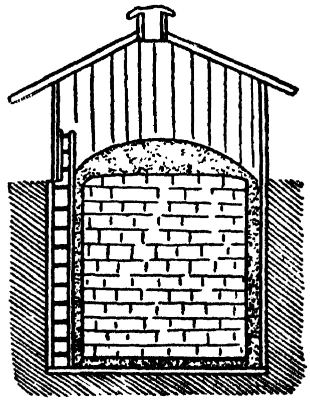


Fig. 253. Ice-house built below surface of ground.

It may seem strange that ice melts faster in ground storage than in surface storage, for during the summer the temperature of the soil is much lower than the temperature of the air, and it would naturally seem that ice would keep better in the ground than in a surface structure. This would be true were it not for the fact that the earth is a good conductor of heat. Experience proves that ice-houses built in the ground must be more thoroughly insulated, and therefore are far more costly than the surface ice-house. The temperature of the earth ranges from 49° to 54° Fahr. under average conditions. This is approximately 20° higher than the freezing point of water. It is

estimated that north of the parallel of $38°$ *there are two hundred and ten days in the year in which* the average temperature is not above $52°$ Fahr. There are one hundred and fifty days in the year during which the ice will melt less in a surface storage from actual contact with the air than in the underground ice-house. Furthermore, we find that the conductivity of the earth is two and one-half times greater than that of the air, depending somewhat, however, on the nature of the soil. This proves the necessity of having good insulation when ice-houses are built below the surface.

Underground ice-houses are practicable only when there is a lack of room. They cost more for construction, besides the expense for excavating and the extra amount of labor required to pull the ice to the surface; while in the surface building it can be thrown down out of the ice-house.

Foundation and floor.—The three essentials in constructing the foundation and floor of an ice-house are as follows: (1) The foundation and floor should be so arranged that they will rapidly drain away the water melted from the ice. (2) The floor should consist of some insulating material that will insulate the ice from the earth. (3) Air currents should not be allowed to circulate in the insulation at the base of the house, as this frequently causes a great amount of meltage. (Fig. 254).

The foundation proper may be made of concrete (which is the cheapest and best), stone or brick. It should be deep enough to prevent the building from settling. The depth may range from a foot to two and one-half feet, with a thickness of one foot to eighteen inches. It is advisable to place a porous

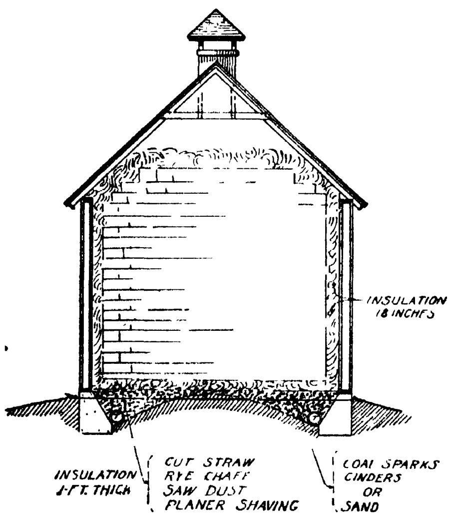


Fig. 254. Ice-house with proper insulation at base.

tile drain along the side of the foundation or through the center of the floor to take care of the ice-water.

The floor should be porous sand, crushed rock or cinders; it should be tile drained, and the tile should be imbedded in a layer of porous material. At the end of the drain, coming through the ice-house, *there should be a trap to prevent the ingress of the air through the tile. The best material to* put on top of the first six inches of sand or fine crushed stone is locomotive coal sparks. If these are not available, light cinders are the next best thing. It is absolutely necessary that this material should be very light, for it then confines air, which produces the insulating effect. At the same time, it does not decompose, and allows the ice-water to pass off rapidly. But when ice-water passes through coal sparks or cinders, they lose their insulating efficiency. It is advisable, then, wherever practicable, to place a thin coat of cement over the cinders, not allowing the ice-water to pass through the cinders, and thus making a better insulator. This adds to the expense of construction, however. In this case, proper drainage must be provided by having outlets in several parts of the building. On top of the cinders should be placed the insulation, to the thickness of at least one foot, depending somewhat on the material used, whether it be chaff, cut straw or sawdust. In all cases the base of the ice-house on the inside should be at least six inches above the outside surface, and the outside surface near the foundation should always be a foot or so higher than the immediate ground surface, in order to drain water away from the building.

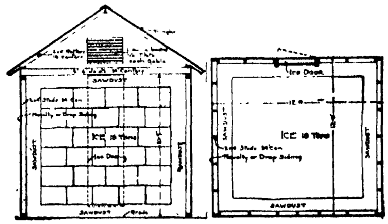


Fig. 255. Detail of small farm ice-house.

The construction of ice-houses.—For an ice-house of the size suggested above for a small dairy-farm, 12′ x 12′ x 12′ outside measurement, the following is the most convenient construction (Fig. 255): The frame should be made of timbers, 2 x 4, laid on the sills, the sills being constructed in a box-sill form. The house may be lined inside with rough boards, but it is not absolutely necessary. The outside may be sided with drop siding or with up-and-down siding, and battened to cover the cracks. If there is an air space between the rough boards and siding it should be filled with some good insulating material, such as coal sparks, planer shavings, sawdust or the like. A felt or shingle roof may be put on, with 2 x 4 rafters, on which are laid the rough boards which support the roofing material. On one side of the building there should be a door through which the ice may be put in and taken out. This door should extend from the top of the building to within four or five feet of the base. It is not wise to extend this door too near the ground, as more or less air will get into the base of the door and melt the ice unless it is perfectly sealed, which makes it more or less expensive.

Ventilation.—Good ventilation should be provided by making two lattice windows on either side of the gable, or a ventilator on top of the roof. This is very necessary if the ice is to be well kept, for the heat frequently penetrates the roof by the

direct rays of the sun, and by means of this ventilator the heat is readily removed.

Insulating materials used for ice-houses.—The best insulating material should possess the following qualities: (1) It should be the best non-conductor; in other words, it should contain the greatest number of small air spaces, for it is the confined air that insulates. (2) It should be a material that absorbs the least amount of moisture. (3) It should be a material that does not decay or burn. An insulating material possessing all of these qualities to the highest degree would be very expensive. Probably the best insulator we have that will comply with the above conditions, and one that can be secured at a reasonable price, is coal sparks. Coal sparks are the cinders that pass through the flue and fall on the front end of a locomotive. They are very light and porous, and poor conductors, but in some cases it is difficult to secure them. It is advisable, therefore, to use materials that are more practicable for farm conditions and that can be found on almost every farm namely, the husks of wheat or wheat-chaff. Cut rye-straw or cut wheat-straw is a very good insulator. Cut swamp-hay, when it is in abundance, is somewhat better than cut wheat-straw. When sawdust is available it is a

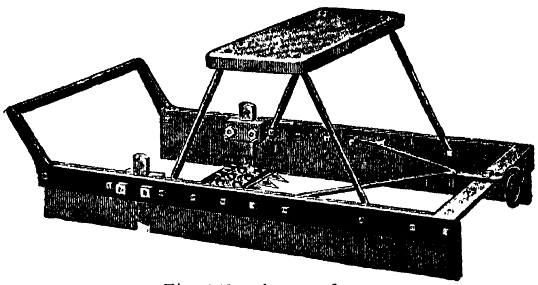


Fig. 256. An ice planer.

very good material for insulating purposes. Planer-shavings may also be used.

The harvesting of ice.—Ice should be cut from a stream or pond that is not stagnant. Lakes or rivers are more desirable to cut from than ponds, but when fresh, running water enters the pond, so that it can be renewed often, there is no danger of harvesting impure ice from such places. Disease can be transmitted very readily by the use of ice harvested from stagnant ponds. If no ice can be secured from clear-water streams or lakes, and a pond is the only place from which to harvest, due care should be taken that the pond is drained and cleaned late in the autumn; and, if possible, a few showers should be allowed to wash the pond before it is again dammed.

There is a great difference in the quality of harvested natural ice. Those who have had experience have noticed that in some cases fully half of the ice is of a light color, while the remainder is clear and solid. The white ice contains much air, which causes it to have that color, while the clear ice is perfectly solid and transparent, and will last longer and give better results than the white ice. Hence, in harvesting ice it is advisable to choose a time, if possible, when the water is frozen quietly, to form a crust of ice to prevent the air entering the lower strata; for it is generally due to the wind blowing over the surface of the water, forcing it on in

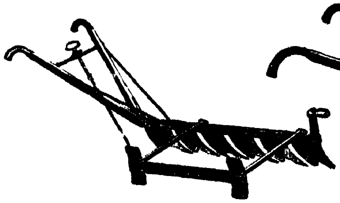


Fig. 257. An ice plow.

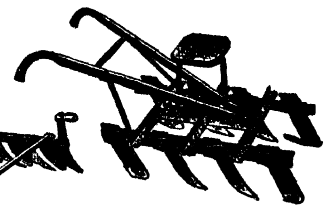


Fig. 258. Twin-cut ice plow.

frozen sheets, or to snow falling on the ice, forming slush and freezing again, that this white ice is formed. If it is quite impossible to secure clear, solid ice, this objection can be overcome by the use of a planer (Fig. 256). By this method, a certain section of ice is planed down to where it assumes a clear color. The shavings are then removed and, if the ice is not thick enough, it is allowed to freeze for a time before it is cut. This will give a perfectly clear ice, and consequently a better quality.

Ice should be cut in square or rectangular blocks. It is essential that these blocks be perfect in shape, so that when set together in the ice-house they will leave a minimum amount of air space. This is done most conveniently by means of an ice-plow (Figs. 257, 258). However, if such an instrument is not at hand, a hand saw can be used (Fig. 259). A plat of ice that has first been thoroughly cleaned, should be marked off into squares and sawed by means of cross-cut saws.

Filling the ice-house.—Before laying the first layer of ice it is very essential to have a well-prepared floor to insulate the heat coming from the earth, for a poorly insulated floor is the most wasteful part of an ice-house. As has heretofore been explained, the ground is a good conductor of heat, and hence, by placing ice on the ground directly, the ice is wasted by cooling the ground beneath it. After applying the insulation as explained in the paragraph under "Foundation and floor" (p. 234), it is essential to place on the cinders at least twelve inches of insulation, and it is better if more is used.

When the insulation has been properly leveled, a layer of ice should be placed on it, with the cakes laid flatwise and close together. Due care should be taken that the first layer is level. On top of this place tiers of cakes

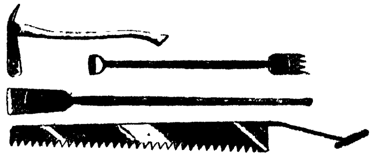


Fig. 259. Ice tools.—Axe, ice-chisel, ice-bar, saw.

set up edgewise, completing each pier and smoothing the top of it with an adz to allow the proper setting of the next tier. Each tier should be set some distance from the edge of the house, depending somewhat on the insulation. There should be at least eighteen inches of insulation between the outside board and the ice, the amount of insu-

lation between the ice and first board depending on the construction of the ice-house. In some instances the wall is packed with some good insulating material a foot thick, while in other cases merely the outside wall is permanent. Ice-houses having the walls permanently insulated by being

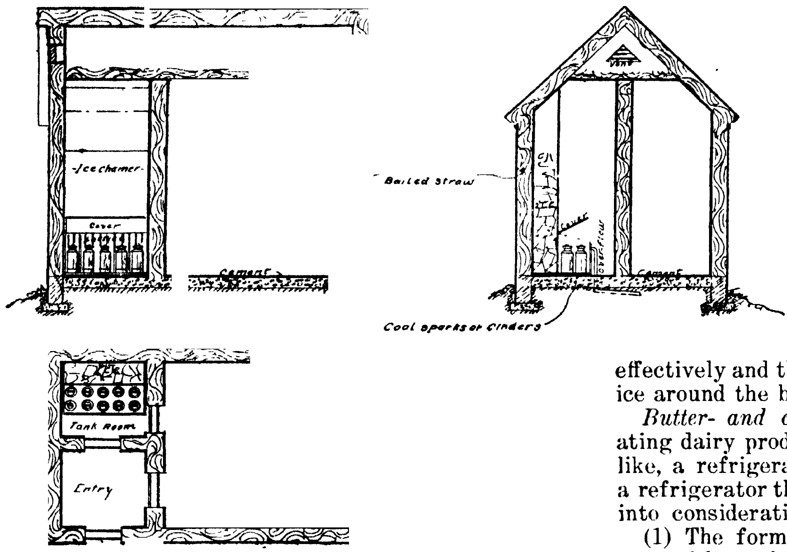


Fig. 260. Use of ice-water tank in cooling milk. This house is built of cement walls, inside and out, filled with baled straw.

boarded up on the inside possses an advantage over the houses constructed without insulation, in that they do not allow the insulation to fall on top of the ice, which becomes exceedingly thick when near the bottom of the bin; and it is a source of annoyance to remove so much of the insulation to get at the ice. The insulation between the wall and ice should be packed as firmly as possible, so that it will not permit the tiers of ice to give way as it is gradually being built up, and not allow any large air spaces.

(b) *Dairy refrigeration as applied on the farm.*

When the farmer is provided with the proper facilities for storing ice, it becomes an important point properly to apply the cooling effect to his products without the loss of a great amount of ice. It is necessary, then, to provide receptacles, the form of which depends on the nature of the product to be cooled.

Milk- and cream- refrigeration.—The most effective way to refrigerate milk, cream or any perishable liquid dairy product is to cool it in ice-water. In this case, a tank (Figs. 260 and 261), which holds ice-water and in which the milk can be placed in a receptacle that is a good conductor of heat, is the most effective method of refrigerating. The tanks holding the ice-water should be well insulated either by constructing them of a thick plank of porous wood, or by two thicknesses of thinner wood, the space between the two being filled with some insulating material, such as coal sparks, rock cotton or some other insulator that does not absorb moisture to any great extent. Cement tanks may also be used for this purpose. If, however, a cement tank is to be built, it should be insulated thoroughly on the inside with some non-conducting material, such as coal sparks or cinders.

Milk-refrigeration in cold storage without application of water is not accomplished so effectively and economically, for the reason that air is a good non-conductor, while water is a good conductor. It is a common practice for milk-supply men to make their first attempt to cool their bottled milk in dry-air refrigerators. In nearly every case this proves to be a failure, unless the milk has been cooled previously to an equal or lower temperature than the temperature of the dry air of the refrigerator. To cool bottled milk effectively and thoroughly it is best to place crushed ice around the bottles when packed in this tank.

Butter- and cheese-refrigeration.— For refrigerating dairy products such as butter, cheese and the like, a refrigerator is necessary. In constructing a refrigerator there are several factors to be taken into consideration.

(1) The form.—The same principles that hold true with an ice-house hold true with a refrigerator. It should be as near the form of a cube or a cylinder as practical, for the most efficient work.

(2) Insulation. – A refrigerator should be thoroughly insulated to allow as small an amount of heat as possible to penetrate the walls.

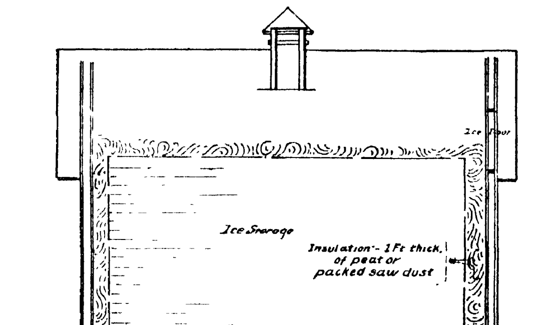


Fig. 261. Plan of refrigerator in which ice-water is used to cool the milk. The milk, in cans, is placed in the ice-water tank.

(3) Dryness.—It is very essential that the refrigerator should be so constructed as to allow the proper circulation of air to keep it dry.

Insulating materials for a refrigerator.—Insulat-

ing materials used for small refrigerators are numerous. (Fig. 262.) There are some very important requisites that need to be taken into consideration when selecting insulating materials for a refrigerator: (1) They must possess the power to resist heat, or should be non-conductors of heat; (2) they should have a minimum capacity for absorbing moisture; (3) they should not ferment, disintegrate or decay; these requisites being similar to that of the insulating material of the ice-house. In connection with these, they should be odorless, so as not to taint the products that are stored in the house; (4) they should not pack or settle down, thus leaving an air space above; (5) they should be reasonably cheap, and lend to practical conditions.

The materials that comply with these conditions are rock cotton or mineral wool. Granulated cork is very effective and charcoal is also used with a great degree of success. Hair felt is a good insulator, and planer-shavings become exceedingly practical because of the cheapness at which they can be secured. Sawdust is also good, but does not prove to be so effective after a year's use as do planer-shavings. Paper has frequently been used, but is not to be recommended for all conditions.

Air spaces are frequently built in refrigerators for the purpose of insulation. While air may be confined to a particular place, it is very important that the air should be made perfectly "dead" in order to prevent circulation. Variation in temperature induces air to circulate, and the greater the variation, the more rapidly will it circulate. The more rapid the circulation, the poorer will be the insulating effect. Furthermore, air spaces built for insulation are very expensive and impracticable.

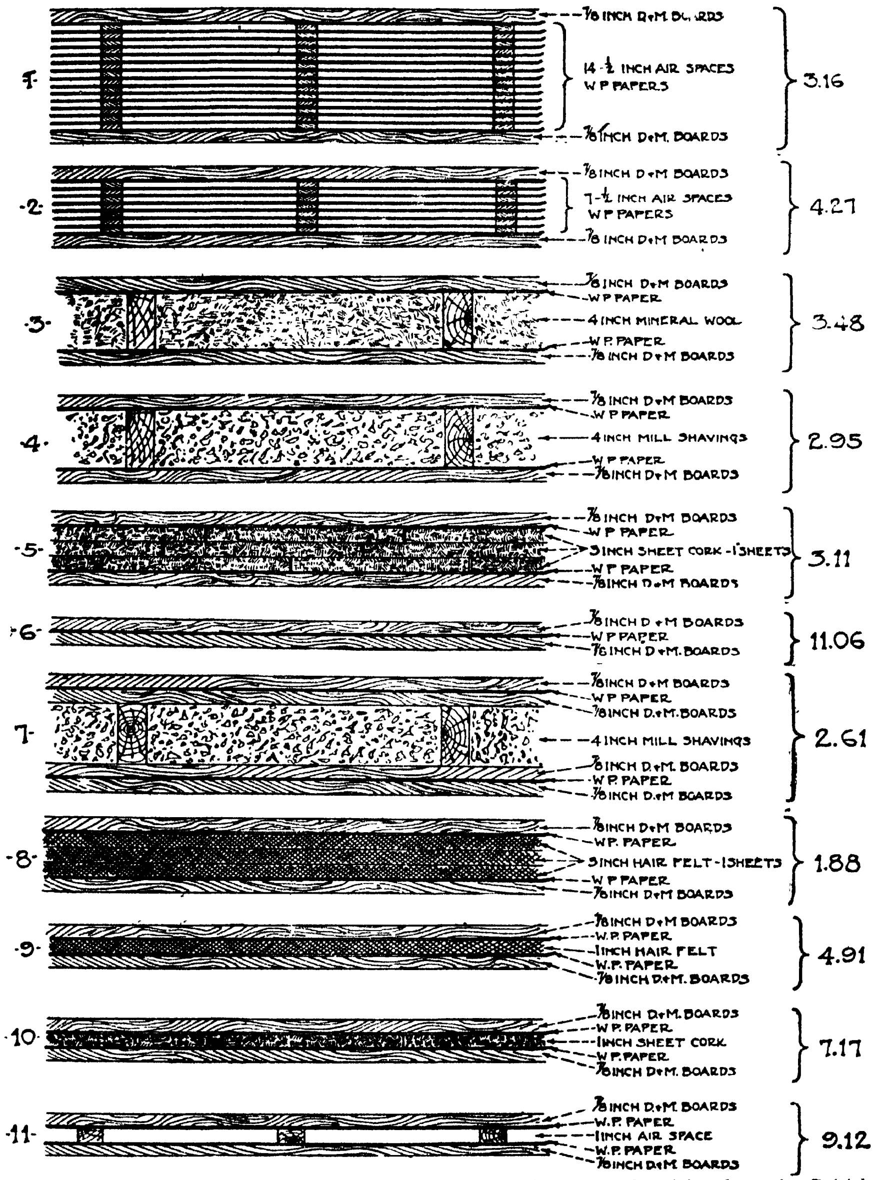


Fig. 262. Methods of insulating small refrigerators. The figures at the right show the British Thermal Units transmitted per day, per degree of difference of temperature. Cooper's test.

Circulation of air in refrigerator.—A refrigerator should be so constructed as to induce the greatest amount of circulation, for the faster the air circulates in the refrigerator the dryer will be the air and the more thorough will be the refrigeration. Confined air is a non-conductor; hence it

is necessary to bring the air into circulation in order to produce a cooling effect.

Bacteriology applied to refrigeration. — Decay is due to the disintegration of material by inherent ferments or by bacteria. Bacteria are microscopic living organisms which act under conditions similar to large organisms, namely, where there is food, moisture and warmth. Some ferments do not grow at all at freezing

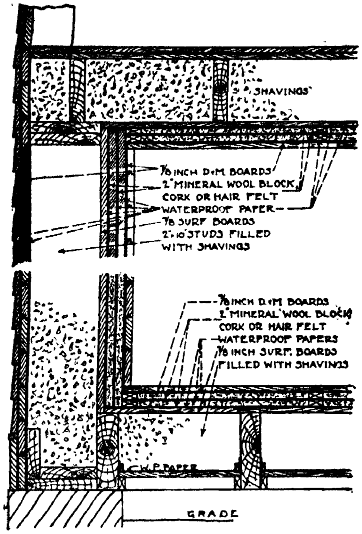


Fig. 263. Section showing insulation for a frame building.

temperatures, and the few that do, develop very slowly. This is why refrigeration preserves perishable products. When conditions are such that moisture, to a certain extent, can be withheld, the preservation can be brought about by higher temperature. This can be applied only on such products as are not liquid, such as butter and cheese. It is readily seen, then, that, if a refrigerator can be kept extremely dry, butter can be kept equally well at a somewhat higher temperature than if moist.

Temperature governs the percentage of humidity of the air. As the air immediately surrounding the ice is chilled, it becomes heavier and at the same time its capacity for holding moisture is lessened. Air that has all the moisture that it can carry is said to be saturated, or to have 100 per cent of moisture. The per cent of saturation does not refer to the actual amount of water per cubic foot in the air, but only to the proportion of water to the capacity at any given temperature. To illustrate this and to show its practical working, we will suppose that air is cooled by ice to 38° Fahr. At this temperature it will hold less water than at 50° Fahr. If at 50° Fahr. it was saturated 90 per cent, at 38° it would have more water than it could carry. The excess would be condensed and deposited on the ice. This is well illustrated in warm weather when a glass of cold water is drawn, when the outside of the glass quickly becomes covered with moisture and is said to "sweat." This moisture comes from the air because the air immediately surrounding the glass is cooled to a point where it is saturated, and the excess of water is condensed on the cold surface of the glass. In just the same way rain is brought about, and the excess of moisture of the air in the refrigerator is deposited on the ice. This cold air, now being heavier, drops down and produces a vacuum, which throws the other and warmer air on the ice. Dryness is

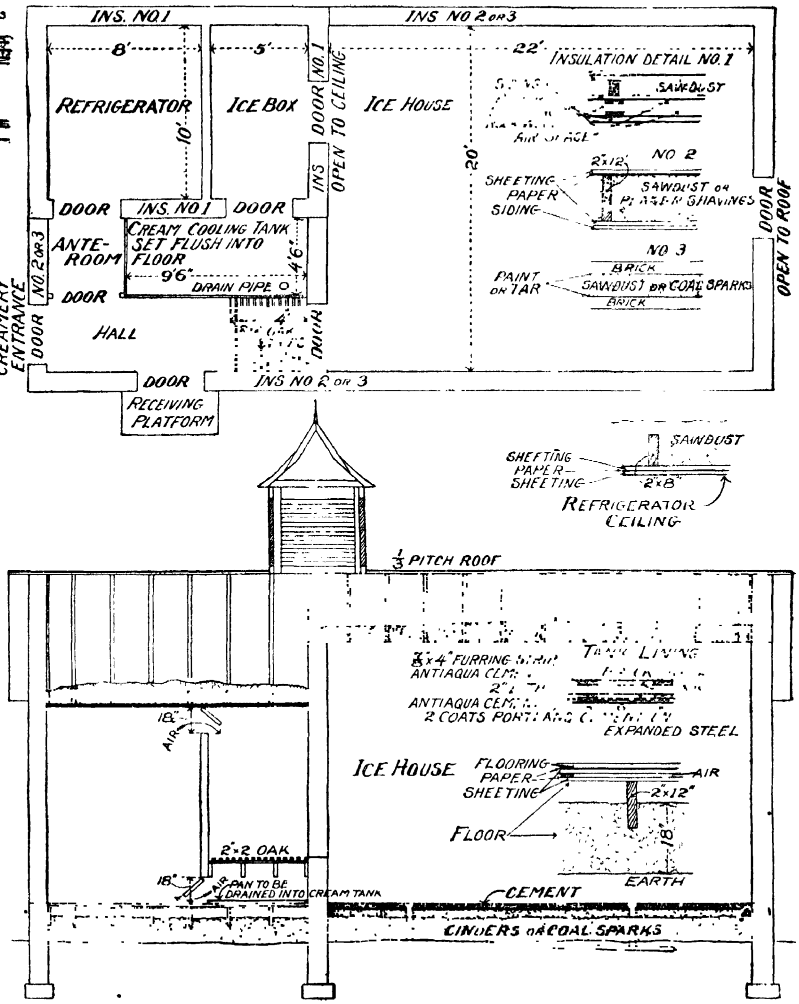


Fig. 264. Plan of cool storage, with ice-house placed on side of storage chamber.

essential in a refrigerator for preserving butter, cheese and the like.

The size of a refrigerator.—The same laws that govern the size of an ice-house govern the size of a refrigerator. A refrigerator should be built of such a size as to supply the maximum storage capacity. The size may be determined by the output of the creamery or dairy. Butter should be shipped every week unless it is to be placed in storage at extremely low temperature. It should then be shipped twice a week. The maximum time for storage should be three weeks. For average conditions, cold-storage rooms in creameries need not be much larger than to hold a week's output of butter, besides the extra room required for handling the packages.

For a creamery refrigerator, it is essential and convenient to have an anteroom before the entrance of the refrigerator in order not to allow any more of the cold air to escape than is necessary. By this method, when entering the refrigerator through the anteroom, the anteroom door should be closed before the refrigerator door is opened. This anteroom can be used conveniently for printing butter.

Light.—It is not desirable to have a window in the cold-storage room. A window may be put in the anteroom, however. If light is necessary in the storage-room a lamp or candle should be used.

Insulation.—The walls, ceiling and floor of the refrigerator should be thoroughly insulated, including the anteroom. All lumber used in connection with the refrigerator should be thoroughly dry and free from odor. The ceiling on the inside, and the siding on the outside, should be free from knots. Spruce, box-elder or hemlock is the best wood for the inside. Soft pine, free from odor, may also be used, but it is generally not suitable for the inside sheeting because of its odor. However, it may be used on the outside. The ceiling on the inside should be well dressed, matched and grooved. Lumber should be dry in order that it may not form cracks, which will allow the air to circulate in the dead-air spaces, and at the same time make it likely to crack the paper.

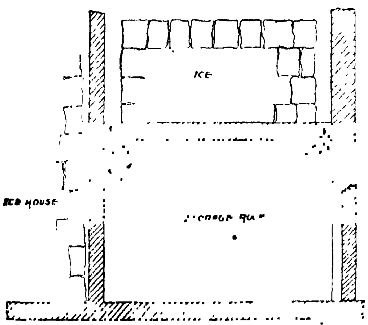


Fig. 265. Diagram of improperly constructed ice cold-storage.

All papers used in connection with refrigerators for butter and cheese should be strictly odorless and waterproof. Such papers as tarred, felt, straw and resin papers are not suitable for this purpose. Only refrigerator paper is suitable for refrigerating work. It is advisable to use a double thickness of paper in all cases, and each layer should overlap the preceding one at least six inches, preferably more. The layer should extend continuously around all corners. Care should be taken that no breaks occur in the paper, and if a break is made it should be covered with another sheet. Dead-air spaces may be made for insulating purposes, but, owing to the expensiveness of constructing an air space, it is advisable to use some insulating material such as rock cotton, asbestos, mineral wool, liner felt, cork, charcoal, or planer-shavings. The shavings must be from some odorless wood, such as spruce or hemlock.

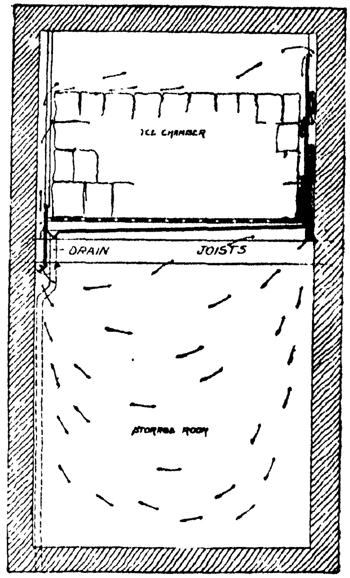


Fig. 266. Overhead ice, with good air circulation.

The thickness of insulation depends on the material used and the construction of the walls. In using rock cotton, at least four inches should be placed in the wall, including three air spaces that would range as follows: One-inch air space, two inches of rock cotton, two-inch air space, two inches of rock cotton, and one-inch air space. When asbestos is used, at least six inches should be put in the wall, with an air space of one inch on each side. When planer-shavings are used, an eight-inch air space should be filled, with no dead-air spaces. For chaff or cut rye-straw, ten inches should be used.

Construction.—The foundations should be made of stone, brick or concrete, and built high enough to allow good drainage to the lower insulation. The floor of the refrigerator should be well drained and then covered with at least eighteen inches of coal cinders. If cinders are not available, coarse sand may be used, or crushed limestone. Place on this a very light, thin coat of cement. On this place joists, which are supported at the ends and are of such size as is necessary to carry the weight of ice and the products stored. Between the joists fill the space with insulating material. On the joists place an inch thickness of lumber, then some insulating material and lastly flooring. (Fig. 263.) Or, place two thicknesses of paper on insulating material, with a layer of fine sand, on which place two inches of cement. The cement should be well turned on the sides of the wall, and the floor should have proper slope of one inch to every two feet, with a gutter on the entrance side of the room to allow for drainage from the melting ice. The drain from the gutter should be trapped to prevent the air entering the refrigerator.

The walls should be constructed of 2 x 4's set alternately and united top and bottom, with two thicknesses of lumber on the inside. The outside should be covered with two thicknesses of lumber, with two ply of paper between. The inside should also have two ply of paper between the two thicknesses of lumber, and the last course of lumber should be matched ceiling.

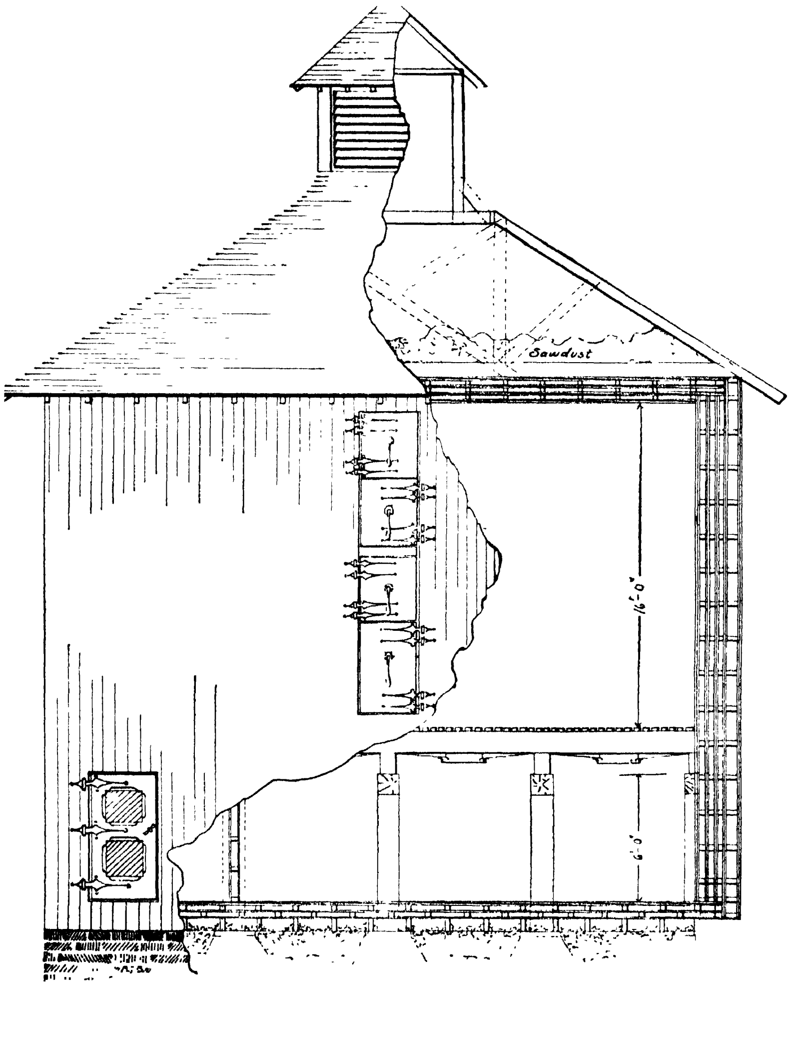


Fig. 267. A satisfactory large cold-storage building, in which the ice for the year is placed as cut.

The insulation should be made according to the plan adopted. The insulation of the ceiling in the refrigerator is not so essential as the insulation of the floor, because cold air is heavy and hovers at the lowest point, hence the variation in temperature at the ceiling is less than around the base of the refrigerator. While the same construction should be applied on the inside of the refrigerator and the same amount of insulation used, it is not necessary to put on the last course of outside lumber.

The doors entering the cold-storage room should be insulated in the same way as the walls. The edges should be beveled closely to fit the door frame. Projections should be left on the door, which should receive a covering of leather, felt or rubber, and should be provided with fasteners so as to allow no possible chance for the air to escape. The inside of the room should receive a coat of shellac or a coat of refrigerator paint to prevent any odor arising from the wood.

Styles of refrigerators.—Refrigerators are built in two styles with reference to the air space and to the ice-chamber, to induce the proper circulation of the air. The first is when the ice-chamber is placed above the storage room and connected with ducts, so as to allow the warm air to rise from one duct and be deposited on the top of the ice, where it is cooled and falls down another duct into the chamber, where it is again warmed by the products in the storage room and rises to be cooled by the ice above. The second (Fig. 264) method is when the ice is placed on the side of the storage chamber. In this case the air cooled in the chamber enters the room through the lower bed course, and the vacuum above draws in the warm air, thereby inducing a circulation.

To induce an air circulation in a refrigerator it is necessary to build flues so that the down flow of the cold air will not be interrupted by the upward flow of the warm air. (Fig. 265.) The air being warmed by the products stored in the refrigerator, it raises the saturation point, which brings on the power for it to take up more moisture. It should then have a chance to rise on the warmest side of the refrigerator through a flue to the top. Here the ice should be located, and as the warm air becomes cooled from being in contact with the ice,

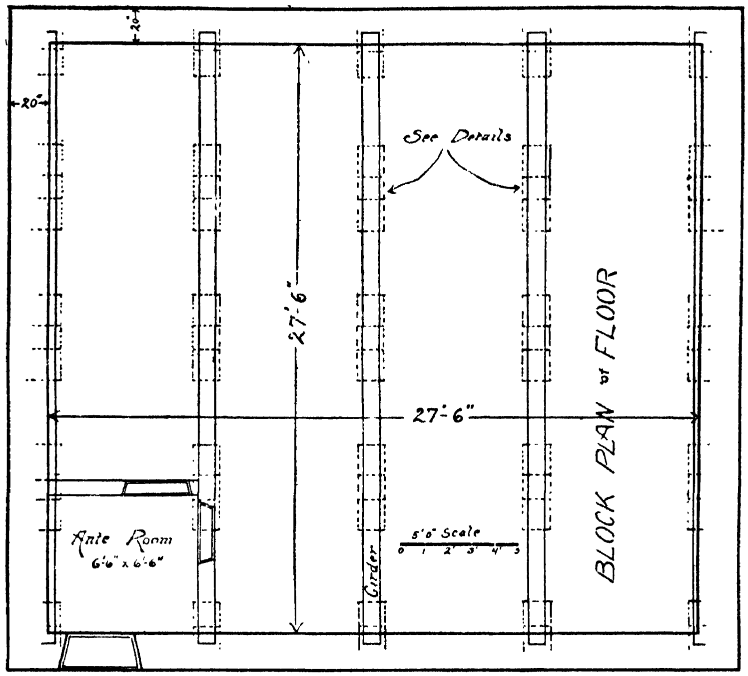
it reduces the saturation point and deposits some of its moisture on the ice. As the air becomes cool it becomes heavy and has a tendency to flow down, hence it is very necessary to provide for a flue in the downward passage of the air. (Fig. 266.)

II. *Refrigeration in dairy manufacturing concerns.*

There are two methods of producing refrigeration in creameries: (1) By natural ice. (2) By mechanical means. While it is impractical to use mechanical refrigeration on the farm, it can be profitably applied, however, in creameries, depending somewhat on the location. In northern countries where ice never fails, and where absolute sanitary ice is not necessary, if a creamery is so located that ice can be stored directly from ponds or streams, it may be cheaper to produce refrigeration by means of natural ice. Following is an experiment conducted by the author to determine the profitableness of refrigeration by the use of natural or artificial means. The question is one that is frequently discussed by creamerymen of the present day; but, because of the varying conditions in the different localities within a small radius of country, it is very difficult to arrive at even an approximate conclusion. An example is here given by which the comparative cost of the two systems may be computed.

Natural-ice refrigeration. – As a basis for our calculations a creamery was chosen, handling, on an average, 10,000 pounds of milk per day. This milk is supposed to contain 4 per cent of butter-fat, from which about 450 pounds of butter are made daily. It is estimated that the temperature of the refrigerator must be maintained at 36° or 37° Fahr. for 250 days per year; or, in other words, there are only 115 days in a year in which the mean temperature remains below 32° Fahr., and during which time no ice is required. It was also estimated that the mean temperature during this time was about 66° Fahr., or a difference of 30°. From the 10,000 pounds of milk, 200 gallons of cream are produced daily, which requires sufficient refrigeration to reduce the temperature 30°, as milk is usually separated at 80° to 85°, and the cream churned at 50° to 55° Fahr.

The advantages and disadvantages of refrigerating with natural ice depend somewhat on the construction and size of the refrigerator. In case the refrigerator is so small that it requires refilling once a week in order to maintain the temperature at 36°, the first cost of building the refrigerator is reduced, but the labor is increased decidedly, as extra expense is incurred for constructing an ice-house to store ice for the season. On the other hand, if a refrigerator is built of sufficient size to store the required ice for the year, the first cost of construction would be comparatively great, but the cost of filling for the year would be materially reduced, as the ice is harvested and placed directly in the refrigerator at the time when labor is cheapest, and when ice has comparatively little value in our northern regions. This kind of refrigerator once filled completes the work and the expense of refrigeration for the entire year. (Figs. 267, 268.)



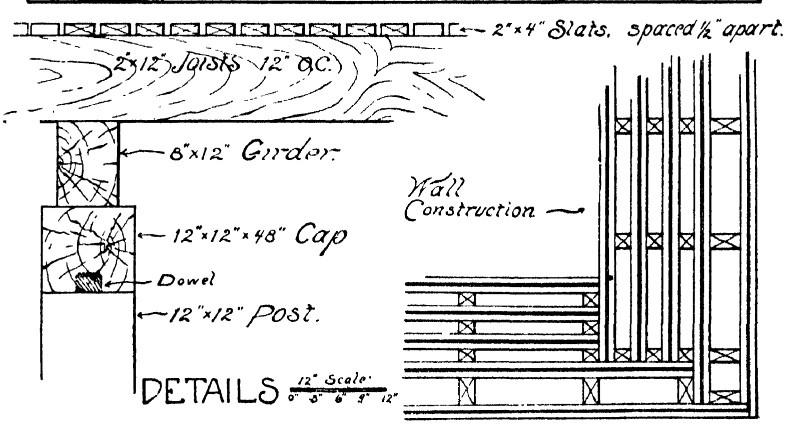


Fig. 268. Details of building shown in Fig. 267.

In the past, a few of these large-style refrigerators were built by creamery companies, but nearly all failed to accomplish the intended results below the latitude of 38°. The practicability of these large refrigerators depends on the thoroughness of the insulation and the latitude in which they are located. They are practical only when walls are built so that not more than seventy-five heat units per square foot are radiated in twenty-four hours, which would necessitate a wall-construction similar to that indicated in Fig. 268. Under these circumstances the cost of such large refrigerators would be too great for the average creameryman. It is, therefore, not appropriate to consider them in this work.

There is a risk to run in depending on natural ice for the year, unless one is situated in a favorable locality where the ice crop has never failed. As a rule, the ice contains a certain amount of impurities, especially when harvested from a stagnant pond, in which case the air in the refrigerator becomes polluted with the impurities set free by the melting of the ice. In natural-ice refrigerators the air is always heavily laden with moisture, making it favorable for the growth of mold on butter-tubs, which is a serious objection. The lowest temperature secured by means of melting ice in a refrigerator during the summer months ranges from 33° to 45° Fahr., depending on the insulation. The better the insulation the more efficient the refrigerator. The cost, therefore, varies with the insulation as well as with the size.

Since the specific heat of butter is .405, the cooling of 450 pounds of butter 30° would require thirty-nine pounds of ice daily, or 9,750 pounds for 250 days. About 25 per cent must be allowed for cooling tubs and packages, which amounts to six tons of ice for cooling 450 pounds of packed butter per year during the 250 days. The space occupied by the 450 pounds of butter packed in thirty-pound and sixty-pound tubs is fourteen cubic feet. If the butter made in one week is to be stored, it requires a refrigerator having 250 square feet of wall surface for heat radiation. The number of pounds of ice that must be stored in a refrigerator over and above the amount required for cooling the butter depends again on the insulation, construction of the walls and wall surface. The illustrations accompanying (Figs. 269–272) are sections of walls showing the manner of construction of the average creamery refrigerator. We find that the average cost of ice in the manufacture and cooling of butter is 18.1 cents per hundred pounds. The average cost per ton of ice placed in a refrigerator is $2.09. In obtaining these results it was the aim to secure, as nearly as possible, the average conditions of northern countries. In Fig. 273 is indicated a creamery with ice refrigeration.

Mechanical refrigeration.—Taking up the disadvantages of mechanical refrigeration, we have:

(1) The large capital invested.

(2) It necessitates daily or continual operation, unless provided with large storage-tanks.

(3) The operating expenses for labor, coal, oil, ammonia and repairs.

(4) The excessive dryness in such refrigerators, often causing a great shrinkage in the product.

(5) Great risks for accidents that might happen, such as the breakage on machines and the delay for repairs.

(6) The expense of pumping water for condensing ammonia.

The advantages offsetting these disadvantages by using machinery for refrigeration, as compared with the use of natural ice, follow:

(1) No risks to run in securing cold whenever needed.

(2) Practically no variation in cost for producing cold from year to year.

(3) The refrigeration is under better control.

(4) Practically any temperature may be obtained above zero.

(5) The atmosphere is drier in the refrigerator; hence, butter is less susceptible to mold.

(6) Less disagreeable labor, such as the handling of the ice.

(7) The cold-room can be kept clean.

(8) It does away with the impurities imbedded in river- and pond-ice.

(9) It provides a more nearly perfect method of cream ripening, resulting in a better product.

(10) It secures economy of space in the cool-room, which lessens the radiating surface for the same amount of refrigeration.

The cost of a mechanical refrigerating plant under similar conditions, and for the same purpose as the natural-ice refrigerators, was obtained from the results of a test made on a six-ton compression refrigerating plant, which has been in operation for over two years. (Fig. 274.) The capacity of the machine is usually considered appropriate for a creamery that handles 10,000 pounds of milk daily; for, with this capacity, it does not necessitate a longer daily run than the time required for operating the factory to do the necessary refrigerating work.

From the average results obtained from this test it is found that one pound of coal produces a refrigerating effect equivalent to 4.7 pounds of ice. This may seem to be a small degree of cold to secure from the use of a pound of coal, yet as near as it can be estimated, it fairly represents the average amount of work of a small creamery refrigerating plant. This inefficiency, however, must not be entirely attributed to the compressor; in fact, the greatest loss occurs in the method of firing, and inefficient boilers and engines. Creameries seldom have high-class engines, and many are exceedingly inefficient; but since the exhaust steam is utilized for heating the skimmed milk and water, this loss of power cannot be considered as waste of fuel.

Repairs have not been taken into account in either case. The estimates on these are very different, depending somewhat, in the first case, on the materials of which the refrigerator and ice-house are built, and on the machine, as well as on the skill of the attendant for operating such machines, in the latter case. However, it is fair to consider the cost of repairs nearly equal in both

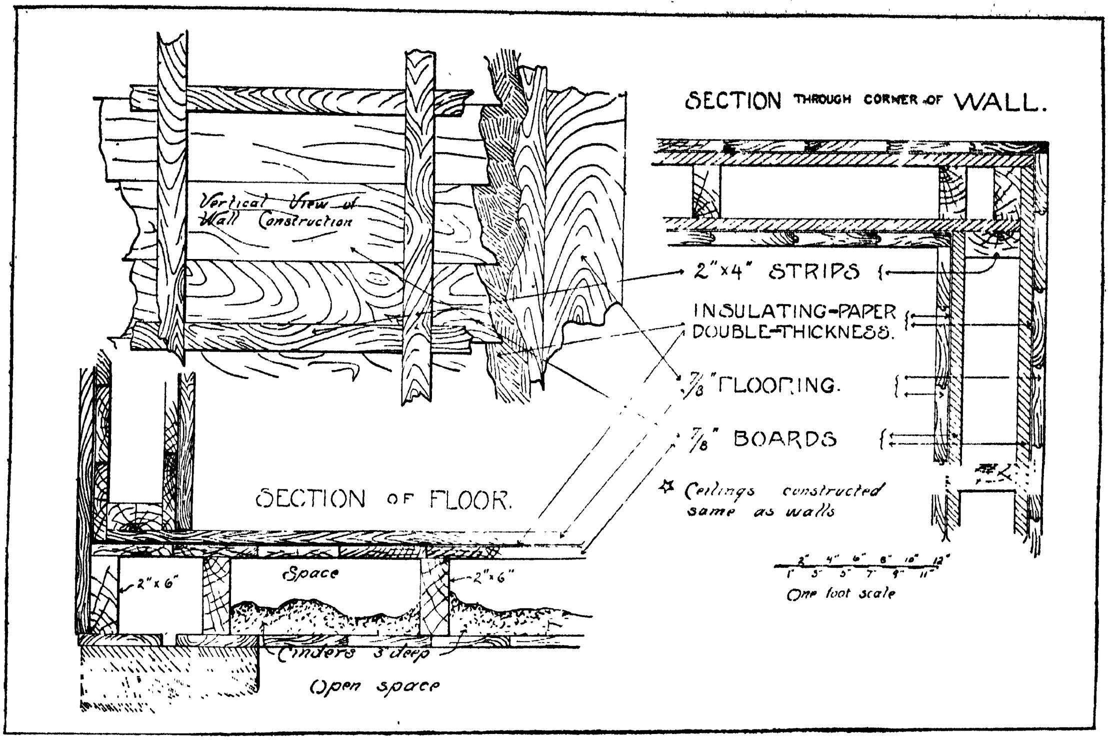


Fig. 269. Sections of wall and floor of the average creamery refrigerator.

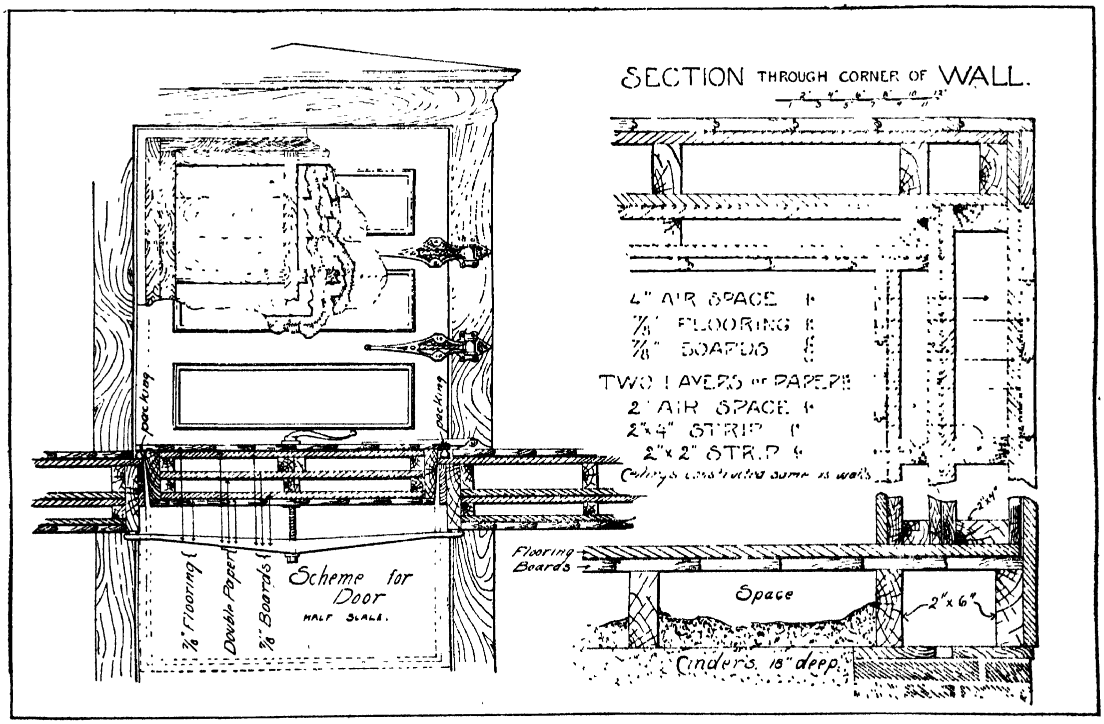


Fig. 270. Sections and details of the average creamery refrigerator.

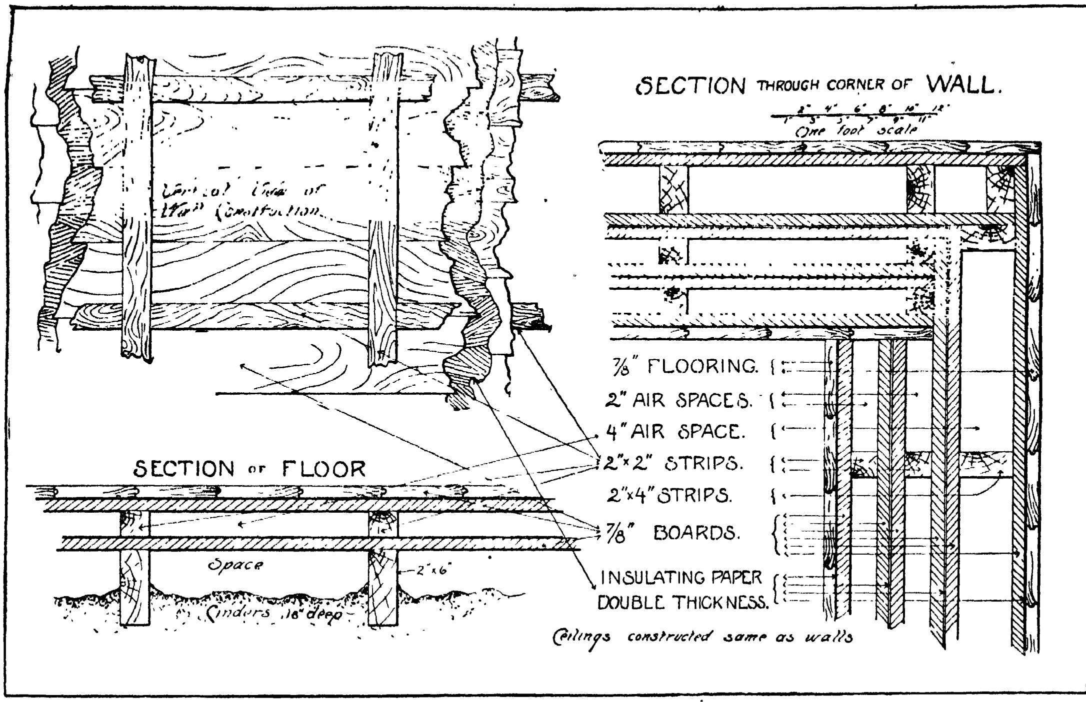


Fig. 271. Further details of the average creamery refrigerator.

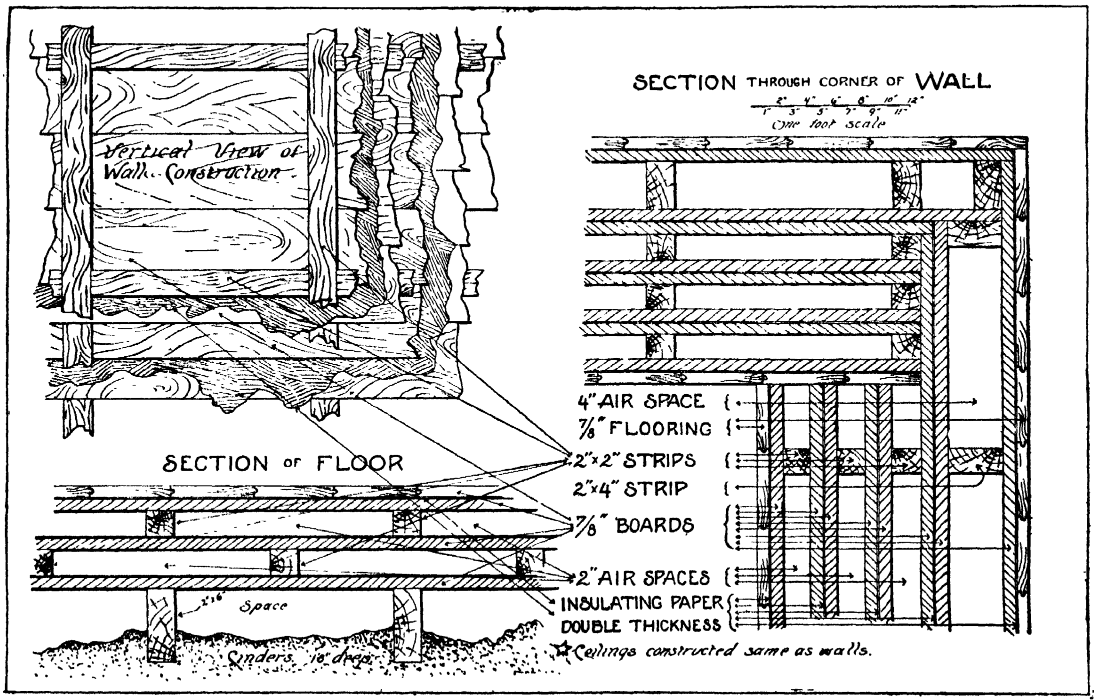


Fig. 272. Details of floor and wall construction of the average creamery refrigerator.

cases. This may slightly favor the refrigerating machines. The storage capacity of the refrigerator is slightly increased by the artificial system compared with the natural-ice refrigerator. The greater part of the space occupied by ice is utilized by the brine-tank, in which brine is stored to absorb the heat which is conducted through the refrigerator walls, while the compressor is not in operation.

Summary.—The difference in cost to cool 100 pounds of packed butter to 30° Fahr., including the cooling of cream during the manufacturing process, between the natural-ice system and the artificial-refrigerating system, is as follows, with the use of various kinds of insulations in refrigerators, as indicated in the illustrations:

	Fig. 269	Fig. 270	Fig. 271	Fig. 272
Natural-ice system (Fig. 273) . . .	20.1c	18.2c	17.5c	17.1c
Mechanical refrigerating system (Fig. 274) . . .	17.8c	17.1c	16.9c	16.8c
Per cent favor mechanical system	12%	6%	4 %	2 %

There is no doubt that the artificial system is the most practical for refrigeration in a creamery handling 10,000 pounds of milk per day, in any part of the country in the same latitude as the state of Illinois (where the experiment was made), except, perhaps, in the extreme northern part, where the cost of refrigeration in creameries may become equal by both systems. But even if this be true, the advantage of refrigerating by artificial means overbalances the natural-ice system.

The fact must not be lost sight of that the proportionate cost of refrigerating by the artificial system increases when the output of the creamery decreases from the illustrations used above. This is due to the increase in capital invested per ton of refrigerating capacity for a small ice-machine.

The construction of creamery refrigerators.—The same conditions that hold true in constructing farm refrigerators also hold true with creamery refrigerators, except that possibly it becomes more economical to use a heavier insulation. Refrigeration in connection with such plants need not necessarily be at lower degree than is produced by ice, unless the creamery is connected with a cold-storage plant, which will be mentioned later.

Refrigeration in cheese factories.—With the present system of making it, cheese is hardly practical to provide for any extensive refrigerating rooms for the purpose of curing the cheese. As cheese is made at the present time, it needs only to be stored until a sufficient quantity accumulates to allow it to be transported to some large cold-storage room, where the proper curing of Cheddar cheese may be done. Hence, a small cheese curing-room, provided with a small ice-chamber to keep the temperature at 45 to 48 degrees, similar to that of Fig. 264, is all that is necessary in connection with refrigeration for cheese factories.

Milk-bottling and distributing plants.—In nearly all of the large cities at the present time some of the milk is shipped from the farm in bulk to a bottling plant, where it is filtered or pasteurized, cooled and bottled. For a large milk-bottling

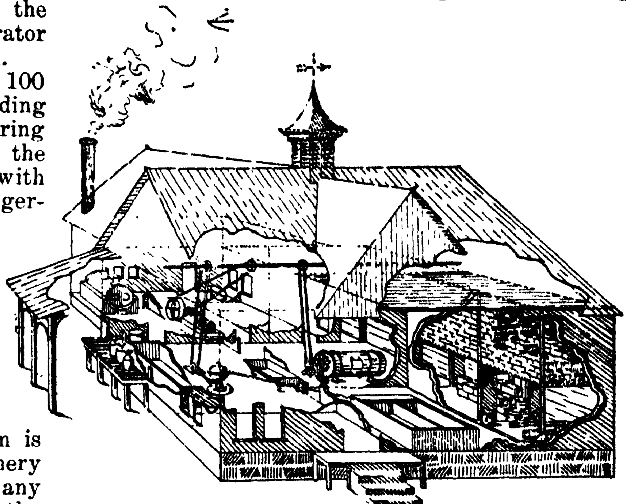


Fig. 273. Creamery with ice refrigeration.

plant, mechanical refrigeration is the most practicable method, but for smaller plants ice may be used. After the milk has been treated as desired, either filtered or pasteurized, it should be run over a cooler, which reduces the temperature to 36° to 40° Fahr. This is the most important step in the preservation of milk in bottling plants. It may then be placed in dry cold-storage rooms for distribution; but the most effective practice is to cool the milk to a moderate degree, bottle it, put the bottles in cases and fill the cases with crushed ice.

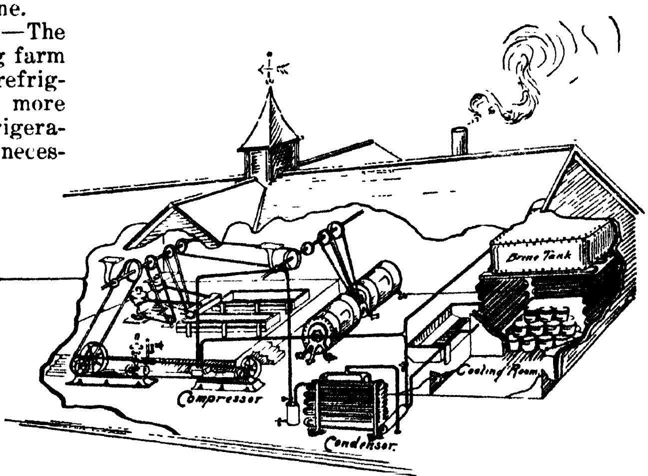


Fig. 274. Creamery with mechanical refrigeration.

III. *Refrigeration in cold-storage plants.*

For butter.—The object of the small refrigerator in a creamery is to allow enough butter to accumulate for shipment to cold-storage houses or for

direct distribution. Further storage room is not necessary for creameries. To produce refrigeration effectively, for the purpose of storing butter for a period of nine months or a year, an extremely low temperature is required, which necessarily must accompany a well-insulated room. Butter stored for this period of time requires a temperature of at least five to eight degrees below zero. This temperature is difficult to secure in any way except by mechanical refrigeration. However, for storage rooms in which butter is stored for a shorter period of time, the temperature need not be so low. Five degrees above zero is probably the most practicable under such conditions. This refrigeration can be secured by a freezing mixture, such as crushed ice mixed with salt. Crushed ice and salt may be placed in tanks containing a series of pipes, which are connected with a second series in the refrigerator. The circulation induced by placing the cold-brine tank above the refrigerator induces a circulation of brine in the pipe and reduces the temperature in the refrigerator. The latter method is known as the Cooper system. (Fig. 275.) Here, again, when ice must be used it is practicable only in places where it can be produced cheaply.

For cheese.—It has been demonstrated absolutely that the only perfect way of curing cheese is in cold-storage rooms. The temperature affects the period of curing; the colder the temperature, the longer time it takes to cure, but the better the quality. The best temperature at which to hold cheese ranges from 36° to 40° Fahr. This is easily produced by ice, and when such a plant is erected for the purpose of curing cheese alone, ice becomes a cheaper and better refrigerator than mechanical methods. But with a combined cold-storage plant, where butter and other perishable products are stored, it becomes equally profitable to provide for rooms in which to hold cheese at 40 degrees temperature.

The same laws that govern the form of ice-houses and small refrigerators should govern the construction of a cold-storage room. The room should be built of such a size as to supply the maximum storage capacity, as estimated by the products to be purchased from the community.

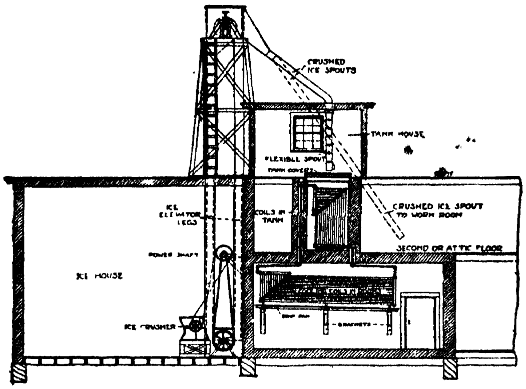


Fig. 275. Section through Cooper gravity-brine system of refrigeration for creamery.

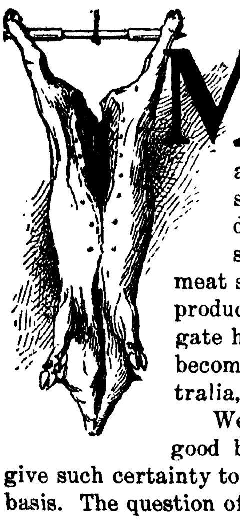
Literature.

The following references should be consulted: Seibel, Compend of Refrigeration; Cooper, Practical Cold Storage. [See pp. 265–270, Vol. I.]

CHAPTER IX

MEATS AND RELATED PRODUCTS

By W. D. HOARD



MEAT-PRODUCTION IS ABOUT TO UNDERGO A GREAT CHANGE in North America, consequent on the change in farming conditions. It is evident to all intelligent observers that the evolution of American farm-life will make several marked changes in the supply of meat. The great ranges where cattle and sheep can be raised cheaply to a certain stage, are fast being eliminated. The supply of hogs has always come from the corn-growing and dairy-producing districts. In such districts the people will be ready for the exercise of a more scientific and economic judgment in order to meet the commercial demands of the meat supply. At the bottom lies the factor of profit to the meat-producer. If he can not produce meat at a profit, then the working of the merciless laws of economics will relegate him to the rear, as it has done very largely in England, and the United States will become an importer of beef and mutton from the great ranges of South America, Australia, and Siberia.

We must determine whether there is any way that the American farmer can produce good beef at a fair profit—whether the American market will hold its prices, so as to give such certainty to the future as will warrant him in organizing his farm on a special meat-producing basis. The question of demand and supply regulates very greatly the question of price. Quality is an additional factor. It is very evident that there is not wide profit in producing a low grade of beef or

mutton. The best profit lies with the best quality. We must determine, then, how this quality is to be secured with profit.

First of all, is the question of breed. On this point there has been a much greater advance in judgment and understanding than on the matter of economic feeding. We have clear and decided breeds of beef cattle and mutton sheep, and no man need stumble or go far wrong in this direction.

The second element in the profitable production of high-quality meats concerns the question of economic feeding, of reducing food-production on the farm to its lowest percentage of waste, as well as of cost, and thus expending that food with the highest efficiency in meat-production; these two problems are as yet but imperfectly understood by the American farmer. Grass and corn are the foundation of all meat-production in North America. Therefore, the meat question involves the other question as to whether the American farmer can produce grass and corn profitably—whether he can grow grass and corn more successfully and profitably than he is now doing. About forty per cent of the meat-producing power of the corn-plant is wasted at present, in all of the great corn-producing sections. This forty per cent is contained in the stalk. If the entire plant is cut at the glazing stage and housed in silos, we are convinced that it would prove a very cheap and efficient food for the production of beef and mutton. But this view of the case calls for a thorough reconstruction of the farmer's ideas of farm economics. The silo has long been known as one of the most efficient and profitable methods for reducing the cost of milk, provided that the silage is properly fed to a cow that can produce milk profitably. The same law applies with equal force in meat-production.

The wonderful spread of alfalfa-culture east of the Missouri in the last ten years has added immensely to the possibilities of cheap milk-, beef- and mutton-production. No more efficient or cheaper ration can be found for meat-making than good field-corn silage and well-cured alfalfa hay. If the animals are comfortably and healthfully housed, a ration of thirty-five to forty pounds of corn silage and ten pounds of bright alfalfa hay requires but fifty per cent of the ordinary grain ration fully to complete the circle of the ration.

Here, in my belief, lies the mode of solving the problem of profitable beef- and mutton-production from the American farm standpoint. Meat-production must become a farm operation, with good supplementary feeding, rather than a range or mere pasture practice. We must apply to it, therefore, the careful and intensive methods of modern agriculture. The more the American farmer studies economical grass-, corn- and alfalfa-production, economical and healthful stabling, and the science of feeding, together with the use of the silo, the more fully will he put himself in possession of the essentials of economic and profitable meat-production. Many other considerations group themselves about this central effort, as the proper lighting and ventilating of stables, guarding against tuberculosis and other diseases, for the more we increase the animal population on a given area the greater are the chances for infection and disease conditions.

Ultimately, therefore, it is a question of the education of the American farmer out of his wasteful, unscientific practice and attitude of mind. If the same exhaustive economy of management were practiced in the raising of beef cattle as is practiced by the packers in their slaughter, this country could produce meat profitably and abundantly from the Atlantic to the Pacific, and meat-production would not be a mid-western practice alone. The limits now assigned for meat-production are based on lack of understanding of scientific and economic methods, rather than in the real nature of things. As a nation of farmers, we are as yet handicapped with pioneer methods of crop-production, and the curing and preparation of crops for animal-feeding. The great mass of farmers have wasted the fertility of their soil to the extent that crop-production is doubled in expense. It is primarily necessary to cheapen and organize crop-production. Most men look at the market end only, considering the price, which they can not control; but they should look first at the farm end, the cost of production, which is largely within their control, if they could but see it. Herein lies very largely the solution of the question of profitable production of either meat or milk on the North American farm.

The general change in the meat situation is indicated in the following editorial in the Wall Street Journal for November 27, 1907; and this editorial is significant as expressing the professional financial judgment on some of the principles governing agricultural investment:

"The life of a western state in which agriculture is the chief source of wealth, presents certain phases of investment interests which apply to no other portion of the country to the same extent. The sources of rural wealth of such a state as Missouri, whose annual agricultural report is at hand, are live-stock and grain. Their present state of production shows that the old order of farm industry has passed away and that the new has become well established.

"The new system of meat-production, for instance, is based upon exact observation of the kind and quantity of feed as a factor in preparation of animals for market. It is not only a question of quantity of product, but, also, one of quality. The feeder of cattle must know at what weight at selling time the maximum net profit emerges. This illustrates the way in which scientific experiment enables the grower of live-stock to find the point of largest return, for, it is this principle that controls the question of breeding, feeding and marketing every variety of stock which the western farm puts upon the market.

"The same principle of maximum average net returns governs the investment in dairying as a branch of the cattle industry. Here the efficiency of the dairy cow, as compared with the beef steer as a producer of human food, is in constant competition. It has been found from Missouri's experience, that, in this race between the two types of food supply, the beef industry is the first to go. One reason for this is that among meat products the costliest is beef, with mutton a close second, and pork third. It is the experience of more than a quarter of a century that, in marketing-values, hogs are the best sellers, sheep ranking next, and cattle below either. Here again is a cause why investment in beef-production is gradually narrowing its territory and yielding to more profitable lines. It is because the margin between producing-cost and selling-price, in an agricultural region like that of the Mississippi valley, is lower in beef than in any other of meat animals.

"Applying the same principle to meat-producing animals, as compared with dairying stock, the relative costs are found to be in favor of the latter and against the former. It is found that dairying thrives better in hard times, and the beef business best in prosperous times. As land becomes higher priced, the work of raising cattle for fattening on the farm must be relegated to the grazing lands of the West. But as these lands disappear it is evident that the cost of young stock production must be increased, making feeders too expensive for profitable purchase. Then the western farmer in such states as Missouri, Illinois and Iowa has before him the choice of selling his grain or of utilizing his products in dairying as the more profitable line of the two.

"It thus becomes apparent that within the surplus corn belt, the whole central problem of farm investment revolves around the question of the function of live-stock in high-grade farming. On lands worth $100 an acre, or perhaps more, no vacillating policy will meet the needs of successful management. To get the largest net profit per acre, the line of production upon which farm efforts center must have the character of permanent profitableness. Yet it must preserve in itself such a degree of adaptability to changes as to be able to substitute the low for the high elements of cost whenever profits are imperiled.

"Thanks to the experiment stations, maintained jointly by state and federal outlay, each state is experimenting in advance of actual farming experience, so that by the time the problem becomes acute in farm practice, these stations have already demonstrated the path along which the more rather than the less profitable investment lies. No other business really has a surer foundation for the present and the future than one in which foresight is demonstrated so completely as to solve its problems in principle by the time they have developed in practice. The meaning of all this to the business world lies in the fact of permanent stability in agricultural welfare combined with a progressive spirit of American farming."

DRESSING, CARING FOR AND PRESERVING MEATS

By *Andrew Boss*

Cleanliness should be the motto of every one who attempts to dress and cure meat for human food. All arrangements for slaughtering and for cutting the carcasses should be made with a view to providing clean, wholesome food. Dirty carcasses and slovenly handling of the cut pieces are extremely objectionable. Not only are they objectionable to the sense of sight, but dirt and blood are a detriment to the keeping qualities of the meat when curing is attempted.

The important factors concerned in the proper handling of meats are discussed in this article. Somewhat full notes are given on the curing of meats for different purposes; and the related subjects of rendering tallow, and the making of soap and candles, are given notice at the end.

Selection of animals.

The selection of animals for meat is of vital importance. Healthy animals in at least fair condition as to fatness are the most desirable. If suffering from fever or any constitutional derangement of the system, the flesh from even a fat animal will not be wholesome food. Frequently animals are killed that are known to be slightly infected with actinomycosis (lumpy jaw), tuberculosis (consumption), cholera, fevers, and other diseases affecting the muscular structure. While there is little direct evidence that meat from such animals is harmful to health when properly cooked, it is almost impossible to distinguish between the incipient form of disease and the fully developed form, or to know

when the disease becomes virulent or harmful. It is safer, therefore, to use for food only meat from animals known to be in perfect health. Flesh from animals that have only recently recovered from an attack of fever or other disease is not likely to cure

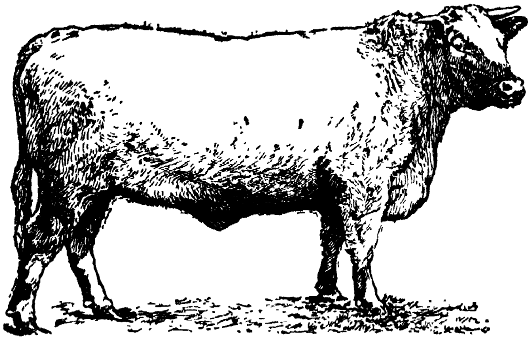


Fig. 276. Beef type. Champion Shorthorn heifer, Lady Amy 7th.

well, nor to keep well after curing; neither is the flavor of such meat of the best. Bruises, broken bones, or like injuries have the same effect on the meat as ill-health, and unless the animal can be bled and dressed immediately after such an accident it is not best to use the flesh for food. A rise in the temperature of the animal just previous to slaughtering is likely to result in stringy, gluey meat that cures badly, frequently souring in the process.

Condition.

A reasonable amount of fat is desirable in meat to give juiciness and contrast in flavor. Within certain limits, the fatter the animal the better the meat. Common practice has perhaps put a safe limitation to the degree of fatness that should be attained, by dictating the selling or slaughtering of the animal as soon as it ceases to make profitable gains on good food. It is a common observation among butchers that an animal that is gaining rapidly in flesh and weight usually makes good meat. One that is no longer gaining flesh or that is losing flesh rarely returns meat of good quality or texture. Meat from the first-described animal stands up firmly under the knife, while that from the latter shrinks in volume when cut, through the loss of water, and when cooked becomes tough and dry.

Age.

Age affects the flavor and texture of meat to a great extent. While it is not possible to fix the age at which an animal will be best for meat, it is well known that meat from old animals is more likely to be tough than that from young animals. Meat from extremely young animals, however, lacks flavor and is not so nourishing and substantial as that from animals that are fully matured. Veal is often taken much too young. An old animal well fattened and in good physical condition would be preferable to a young one in poor condition and thin in flesh.

Quality.

The best quality of meat is usually secured from well-bred animals. Scrub and native stock are frequently coarse in bone and texture of flesh, and do not fatten so readily as stock that has been brought to a better standard of quality by several generations of selections for a specific purpose. Animals that are low and smooth in frame, wide in proportion to depth, and thickly fleshed, generally yield a larger percentage of dressed carcass than animals of an opposite conformation. (Fig. 276.) In addition, such animals trim out less bone and yield a larger proportion of meat from the choicer cuts of the carcass. It is usually found, also, that the thick-meated types of animals, when properly grown and fed, furnish a more nicely "marbled" flesh (Fig. 67), that is, a better mingling of the fat and lean, and that the bundles of muscle fibers composing the lean part of the meat are finer in texture, larger in volume and bound together with proportionately less connective tissue. Such meats are found, therefore, to be more tender and palatable.

Equipment for handling.

Only a few simple tools are necessary for dressing and cutting farm meats. A six-inch curved knife for skinning, a six-inch sticking knife, a steel, an axe, a pritch, a candlestick scraper, and a twenty-eight-inch meat saw are sufficient tools for rapid and effective work. A twelve- or fourteen-inch steak knife should be added to the equipment

Fig. 277. Carcass of beef raised by hitching a horse to a 6-inch block and tackle suspended from a convenient tree. The beef is out of the reach of dogs or other animals.

for slicing heavy steak when the carcasses are cut up. Arrangements should be made for raising the carcasses from the ground or bench, but since local surroundings often determine the manner of raising, it is only suggested that a block and tackle suspended from a tree, a home-made windlass, or even a lever can often be used to good advantage and at little expense. (Figs. 277, 278.) One of the essentials to a clean carcass is a clean place in which to do the work. A clean spot on the grass, or a bed of clean straw far removed from foul odors, fresh paint or other objectionable taints, and where there is good drainage, is satisfactory in most cases. When the dressing of meats is much practiced, a plank or cement floor that can be thoroughly cleaned and drained is preferable.

Fig. 278. A handy device for hanging up a hog.

Preparation.

Animals intended for slaughter should be kept off feed twenty-four to thirty-six hours. On full feed, the system is gorged and the blood, laden with assimilated nutrients, is driven to the extremities of the blood-vessels or capillaries. Under such conditions the blood-vessels do not drain out so thoroughly when the animal is bled and a reddish, unattractive appearance is given the carcass. Food in the stomach decomposes rapidly after slaughter, and when dressing is done slowly, the gases generated by the decomposing food often taint the meat. Water should be given freely up to the time of slaughter, as it tends toward a normal temperature, and washes the effete matter out of the system, resulting in whiter fat and a more inviting carcass. Excitement previous to slaughtering also prevents the proper drainage of the blood-vessels, and if extreme will cause souring of the meat soon after dressing. Overheating, occasioned by violent exercise, such as a rapid run about the pasture, is almost sure to lead to bad results. The flesh from an animal subjected to such treatment is usually pale in color and often develops a sour or putrid odor within three or four days after being dressed. Bruises cause blood to settle to the part of the body affected and present an uninviting appearance, and the loss of a considerable quantity of meat results. A thirty-six hour fast, an abundance of water, careful handling, and rest before slaughtering are advisable, since they affect materially the flavor and keeping qualities of the meat.

Dressing cattle.

In dressing cattle, the animal should be secured to a post, tree or other fixed object near the place of slaughter, by a piece of rope three-fourths of an inch or larger in diameter. By making a running noose around the animal's neck, and in front of the horn on the left side, the face will be left bare for the stunning blow. If the animal is polled, a halter on the head, or a noose about the neck will suffice. The other end of the rope should be passed around the post or through a common hay-fork pulley attached to or near the base. The head should be drawn down to the ground as closely as possible, and the animal stunned by a blow in the center of the forehead, midway between the horns and eyes, and on line with the center of the face. (Fig. 279.) Shooting has the same effect, but the use of firearms about farm buildings is attended with some danger and the use of the axe, therefore, is advisable if the animal can be securely fastened.

Bleeding.—Bleeding is best accomplished by sticking the animal just in front of the breast-bone or sternum. (Fig. 280.) The skin should be split open over the windpipe for a distance of fifteen to twenty inches. An incision some four to six inches

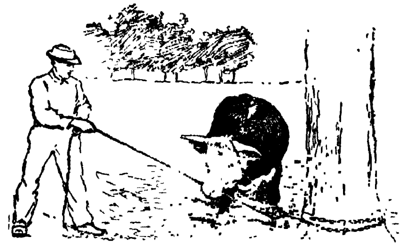


Fig. 279. Preparing to stun a steer. Point to strike shown by crossed dotted lines on head.

deep, depending on the size of the animal, should then be made on either side of the windpipe, the knife being held in direct line with the spinal column. In this way the arteries from the heart and the

jugular veins are both severed close to the heart where the openings are large and resistance is not great. As a result, the blood flows freely and is more completely siphoned out of the smaller blood-

Fig. 280. Sticking a beef. The knife is inserted at center of breast-bone and point directed toward top of shoulders. Back of knife is laid against front of breast bone and veins and arteries cut by forward thrusts of knife below and above windpipe.

vessels and capillaries near the surface. The pleura should not be punctured with the knife, or blood will flow into the chest cavity, causing a reddish tinge on the inside of the ribs, which is not desirable. Not so much skill is required simply to cut the throat back of the jaws, but bleeding will be neither so thorough nor so rapid.

Skinning (Fig 281).—As the animal lies on its side, the face and sides of the head should be skinned back to and over the poll, the tongue being removed by cutting on each side next to the jaw, and severing from the roof of the mouth. By plunging the tongue immediately into a pail of warm water and scraping it with a knife, it can be easily and quickly cleaned. After removing the head, the animal should be rolled on its back and held there by the use of a pritch,—a stick thirty to thirty-two inches long with a spike in each end. Beginning on the front legs by cutting across at the lower knee-joint, the skin should be split over the back of the leg below the knee and skinned down around the shank, leaving the dew-claws on the hide. The brisket, neck and forearm should not be skinned until the animal has been hung up, the covering aiding greatly in keeping the meat clean. Cutting across the cord over the hind shin will relax the foot. The skin may be split and the shank removed as in handling the forelegs. The skin should then be opened over the midline from breast to rectum. With a very sharp knife held nearly flat against the surface of the tightly stretched hide, the skin may be removed down over the sides of the body. If the strokes of the knife are in line with the direction of the layers of muscles, there will be less likelihood of gashing into the membrane covering the flesh. Gashes in this covering or in the flesh are objectionable, as mold forms quickly in such places and is removed with difficulty. The appearance of the carcass is also much better when it is left smooth. A coarse cloth and a pail of hot water should be at hand while skinning and all blood sponged from the surface before it sets. The cloth should be wrung nearly dry for the purpose and no water left on the carcass to form slime or become streaky and collect dirt. The carcass should be opened at the belly, pulling the intestines out to one side and cutting the sternum and pelvis with a saw or sharp ax. The windpipe and gullet should be raised and the diaphragm and pleura cut loose along the lower part of the cavity. The carcass should then be raised to a height at which it is convenient to remove the hide over the thighs, rump, hips and back. (Fig. 282.) The intestines may also be best removed at this time by loosening the rectum and allowing them to drop down over the paunch. The "bed fat" lining the pelvis and the kidney fat should not be disturbed. But little cutting will be necessary for the remainder of the operation. Ordinarily the entrails will drop out of their own weight as the carcass is raised. The intestines and gall-bladder should be handled carefully to avoid spilling the contents over the meat. The hide may be removed over the shoulders, arms and neck ; and the liver, lungs and heart removed as the carcass is split into halves and raised from the ground. Finally, all blood and dirt, both inside and out, should be sponged off, scraggy pieces and bloody veins trimmed off, and the carcass left to cool and set.

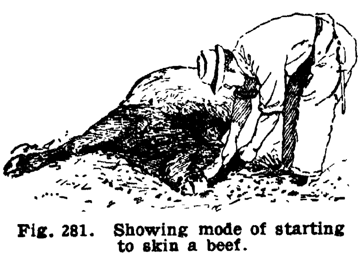


Fig. 281. Showing mode of starting to skin a beef.

Fig. 282. Skinning the shoulders and neck of a beef. The carcass is left covered until raised from the ground, for the sake of cleanliness.

Veal.

Veal for home use should be handled and dressed in much the same way as beef. In dressing for

shipment, only the head, feet and entrails are removed. The liver and sweetbreads are left in the carcass and the skin is not removed but serves to keep the flesh clean in shipping.

Hides.

Hides are easily kept in the North during the winter by freezing, although salting is a precaution. In warm weather, however, they should be spread out flat, hair side down, and all parts rubbed thoroughly with salt. If more than one skin is to be salted, they may be spread one on top of the other and salted as spread with the hair side down. Ten to twelve pounds of salt will be sufficient to preserve an ordinary hide. [See article on *Tanning Hides*, page 271.]

Dressing sheep.

A clean, dry place for dressing and a rack or beam on which to hang the body are essential to cleanly dressed and nicely flavored mutton. Rapid dressing is also desirable, as the generation of gases in the stomach and contact of dirty fleeces with the warm flesh are largely accountable for the objectionable sheepy flavor of mutton. If the animal can be laid on a platform or box six or eight inches high to be bled, it will aid materially in keeping the wool dry and the carcass clean. (Fig. 283.) Some persons prefer to swing them by the hind-legs.

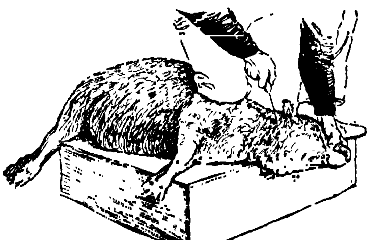


Fig. 283. Sticking a sheep. The knife is inserted just back of ear at point of jaw and penetrates the veins as thrust through to opposite side.

Sheep are not usually stunned before bleeding. The common practice is to cut the throat to the neck bone just back of the jaw as the animal is held on its side. (Fig. 283.) The neck should be dislocated immediately at the atlas joint to prevent suffering. The pelt should then be opened over the middle line and the forelegs skinned and unjointed at the toe joints if mutton, or at the highest ankle joints if lambs. The brisket and sides are most easily skinned as the body lies on the floor or raised platform. Care should be exercised to prevent tearing the red muscles and the membranes covering the sides and abdomen.

The hind-legs should be skinned just above the hocks. On the inside they may be skinned all the way up. The toes should be unjointed and the legs tied together firmly, and the carcass hung up. The outside of the thighs may then be skinned by working the closed fist with upward thrust between the skin and flesh. Stretching the skin tightly renders the operation less difficult. The sides, shoulders and back should be finished in the same way, cutting the head off with the pelt at the atlas joint.

As the animal hangs, it is well to cut around the gullet and open the lower part of the neck to allow drainage of blood. The entrails are removed without opening the sternum or pelvis. The omentum or caul fat should be removed before taking out the paunch and preserved in lambs or young sheep to spread over the thighs and abdomen. The carcass should be sponged off with a coarse cloth as in beef, trimming off the scraggy parts, and then be hung away from flies and foul odors to cool.

Fig. 284. Sticking a pig. The knife is inserted at hollow of neck about an inch to an inch and a half in front of the breast-bone. It is directed toward the junction of loin and hips and thrust deep enough to reach the arteries—six to seven inches in a 200- to 250-pound pig.

Dressing hogs.

The same preparation as advised for cattle is recommended for hogs. A strong table or box on which to scrape, and a barrel or vat in which to scald should be provided, as well as a place for hanging up the carcass.

Killing.—It is not customary to stun hogs before sticking them, although it is sometimes done. They may either be suspended by the hind-legs or, as commonly practiced in farm slaughtering, be turned on the back and held until stuck (Fig. 284). The knife should be inserted in front of the breast-bone and guided directly over the spinal column and toward the root of the tail. Care should be used to avoid sticking to side of the ribs, causing blood to settle in the shoulders. It is best not to strike the heart in sticking, but to turn the knife to one side and then the other, thus opening the arteries on each side and insuring quick and thorough bleeding.

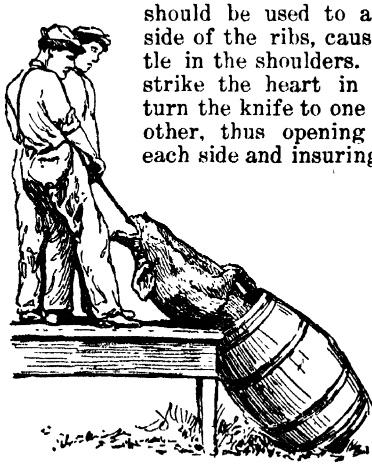


Fig. 285. Scalding a hog. Note arrangement of table and barrel.

Scalding. (Fig. 285.) — The water for scalding should be at a temperature of 185° to 195° Fahr. If it is too hot, the hair will set, causing trouble to remove, and the skin, being cooked, will crack open. Hardwood ashes or lye, or even soft-soap, will aid in removing the scurf from the body. The hog should not be scalded before life is extinct, or the blood in the capillaries will be cooked, giv-

ing a red tinge to the carcass. When the hair starts readily on "airing," remove the hog from the water and scrape thoroughly, removing the hair and scurf by shaving clean with a sharp knife.

Dressing.—The carcass should be hung up before removing the entrails. The pelvic arch and sternum or breast-bone should first be split, then the entrails removed by opening down over the middle line. The large and small intestines should be removed without disturbing the kidney fat. If a heavy hog is to be dressed in warm weather, it is sometimes advisable to remove the kidney fat or leaf and split the carcass into halves to hasten the cooling. The tongue, gullet, lungs and heart are removed in one piece. A block should be placed between the jaws of the hog to hold them open for drainage and the cavity washed out with cold water, and the carcass left suspended until cool.

Cutting up meat.

For neat work in meat-cutting, a short, curved knife, a twelve- or fourteen-inch steak knife and a twenty-six-inch meat saw are essential. An eight-inch cleaver is also advisable. A block of some kind should be provided, substantial enough to stand the weight of a quarter of a beef or hog carcass. A cross-section of a large log can often be made to answer the purpose, and in many cases, an ordinary table will suffice. In cutting meat of any kind, one should always cut across the grain of the meat when possible. Following this principle will result in uniform pieces, and the meat will carve in better form for table use after cooking. Unless the meat is frozen, it should always be cut to the bone with a knife, and a saw used only through the bone. Sawing the bone is preferable to chopping, inasmuch as it does not splinter or shatter the bone. Chopping a round bone with a cleaver often causes splinters to enter the meat, and these are found to be disagreeable when the meat is served. Meat should not be cut until the muscles have set firmly and the animal heat has all been extracted.

Cutting beef. (Figs. 286, 287.)—When the beef is in proper condition, the halves should be divided into hind and fore quarters, cutting between the twelfth and thirteenth ribs, S to T on the accompanying illustration. This leaves only one rib in

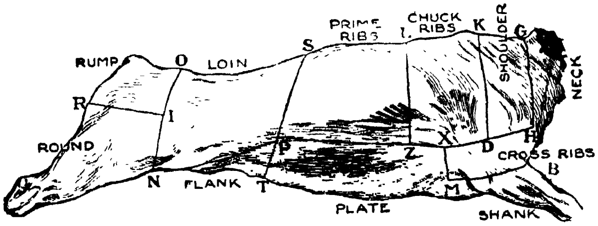


Fig. 286. The cuts of beef.

the hind quarter. In cutting the hind quarter, it should be laid on the block with the inside up, and the kidney and suet removed, and the flank cut off, N to P. The quarter should then be turned over, and the loin removed, cutting from O to N. The round may then be turned over, and the rump separated from the round-steak on the line R to I. The loin contains the sirloin and porterhouse steaks. The round is usually cut into fillets of beef or round-steak, and the rump used either for pot or oven roasts.

The front quarter is laid on the block with the

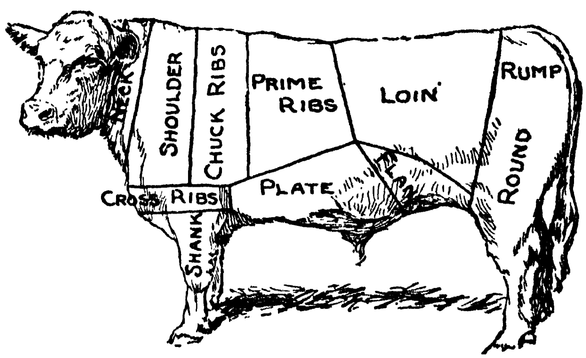


Fig. 287. Utilizing beef. Neck: hamburg, mince meat, beef sausage; shoulder: steak, boiling beef; chuck ribs: steak, roast, boiling beef, corned-beef; cross ribs: pot-roast, corned-beef; shank: soup bone; prime ribs roast; plate: stew, hamburg steak, corned-beef; flank: stew, hamburg steak, corned-beef, flank steak; loin: porterhouse, sirloin and tenderloin steak, choice roasts; rump: roast, corned-beef; round: steak, roast, dried beef, pot-roast.

outside up. Beginning at P, about ten to thirteen inches down the rib from the spinal column, cut across the ribs toward the armpit above M, and cut between the third and fourth ribs to M, and across the shank to B. The "cross ribs" are removed just below the shoulder joints, H to X. (The "plate" and "cross ribs" are the inferior cuts of the front quarter, and usually sell for low prices). With the outside of the beef still up, the "prime ribs" are next removed from L to Z. This cut contains seven ribs and is usually taken off in one piece. The neck and shoulder are divided G to H, and the shoulder and "chuck ribs," K to D. These are the wholesale cuts of beef and are too large for family use. They may be divided again into joints of suitable size for the table as wanted, observing the principle mentioned in a former paragraph, namely, that of always dividing across the grain of the meat. The "prime ribs" may be boned and sent to the table as rolled roasts. This results usually in loss of meat-juices and flavor, but it is a convenience to the carver. The under part of the front quarter is usually served on the farmer's table with the bone in. The "chuck ribs," shoulder and neck are used for boiling pieces, soups and mince-meat, the age of the animal and the toughness of the muscle fibers often determining the method of cooking.

Cutting mutton. (Figs. 288, 289.)—First split the carcass in halves, using a saw or a very sharp cleaver and cutting down the center of the spinal column. The leg should be removed at the top of the round just over the hip-joint and the shank removed below the fleshy part of the leg. The shoulder is removed between the third and fourth ribs and the neck at the shoulder-vein or at the junction of the neck with the shoulder. The

front shank is removed at the elbow-joint. If a saddle of mutton or of lamb is wanted, the carcass is not split through the center but both legs removed at once and the saddle or both loins left in one piece. Mutton-chops or lamb-chops are secured by slicing the rack and the loin between the ribs and across the tenderloin and sirloin muscles. Rib-chops should be one rib thick. The shoulder and legs are used for boiling and roasting pieces, the loins may be roasted although they are usually cut into chops, and the plate and flank are used for stews.

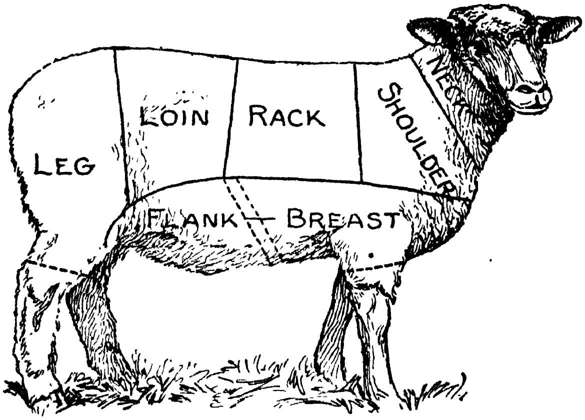


Fig. 288. Utilizing mutton. Neck: stew; shoulder: chops, roast, boiling; rack: chops, roast; loin: chops, roast; leg: roast, steak; flank: stew; breast: stew; shank: stew.

Cutting pork. (Figs. 290, 291.)—Pork should be cut up and the parts desired for curing salted just as soon as may be after the carcass is cooled through. If the carcass has not been split through the spinal column for cooling, it may be laid on the block and the head removed between the fourth and fifth ribs, and the hams about two inches in front of the pelvic bones (Fig. 291). The hams, shoulder and middle pieces may then be split through the center more easily than if the attempt is made before the carcass is cut into sections. The ham should be trimmed to a smooth, round piece with all surplus fat removed for lard. The feet may be removed at the hock with a knife, or about two inches above with a saw. The leaf-lard may be removed from the side, if not already done, when the hog is dressed. The lower two-thirds of the side should be removed, sawing across the ribs. The loin should then be removed, care being exercised to take only the lean meat with the ribs. The spare-ribs should be removed from the lower strip and the scraggy edges trimmed off for sausage-meat, the remainder of the side being cured for bacon or for salted pork. Sometimes the ribs are taken out entire. After removing the ribs and neck-bones from the shoulder, it may be trimmed into a small "California ham" or left in one large piece for curing. All bloody spots should be trimmed out and every precaution taken to remove any elements that may tend to cause souring in the curing process. The head is usually worked up into head-cheese and sausage-meat. All pieces intended for curing should be cut in as compact form as possible, to avoid waste of room in the vessel in which the curing is done. Lean trimmings are converted into sausage-meat and the fat trimmings tried out for lard.

Cutting veal.—Veal may be cut in a way similar to mutton, the only difference being that the rump must be trimmed off before the fillet of veal can be secured.

Curing meats.

Meat must be properly and thoroughly cooled to insure good keeping qualities when cured. If salted before the internal temperature is reduced, the shrinkage of the muscles causes the retention of gases, giving an offensive odor to the meat. Neither should meat be frozen when salted, as the action of the frost will prevent the proper penetration of the salt and uneven curing will result. It is important, also, that meat be cured as soon as cooled and while fresh. Tainted meat may be cured so that it will keep, but nothing in the line of preservatives can bring back the natural flavor when it is once lost. The safest rule to follow is to salt meat as soon as the animal heat is out, and before it freezes or starts to decay. Ordinarily, twenty-four to thirty-six hours after slaughtering will allow sufficient time for cooling.

Vessels for curing.—A clean, hardwood barrel is a suitable vessel in which to cure meat. A barrel made for the purpose is best, but when it can not be had a molasses or syrup barrel will answer. A kerosene barrel that has been burned out and used for water for some time is often used for meat. The important point is to have the barrel clean and tight enough to prevent leakage. A large stone jar is the best vessel that can be had. One holding twenty-five or thirty gallons is expensive, however, and must be carefully handled to prevent breakage. The jar is more easily cleaned than a barrel and is in every way preferable if the first cost can be afforded. A barrel or jar that has once held meat can be used again and again unless meat has spoiled in it. If used repeatedly it will be necessary to scald it out thoroughly before packing with fresh meats.

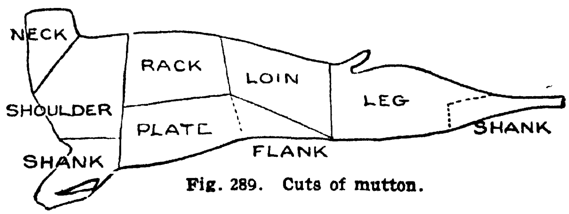


Fig. 289. Cuts of mutton.

Preservatives.—Salt, saltpeter, and sugar or molasses are the most commonly used preservatives, and are the only ones necessary for perfect curing and the finest quality of cured meats. Borax, boracic acid, formalin, salicylic acid, and other chemicals are sometimes used in preserving meats, but they are considered by so many authorities to be harmful to the health of the consumer that their use should be avoided. Salt is an astringent,

and when applied alone to meat renders it very hard and dry. Its action is first to draw out the meat juices. In a few days it will contract and harden the muscle fibers, thus shrinking the volume of meat. Saltpeter is even more astringent than salt. Its use aids in retaining the natural color of the flesh. It may be harmful to the health. Sugar is not an astringent and its presence in the pickle softens the muscle fibers and improves the flavor of the meat. Saleratus (baking-soda) sometimes is used in small quantities to sweeten the brine. In warm weather a small quantity will aid in preventing the brine spoiling.

Curing in brine and dry-curing compared.—Brine-cured meats are best for farm use, for the reason that a suitable place for dry-curing is not usually

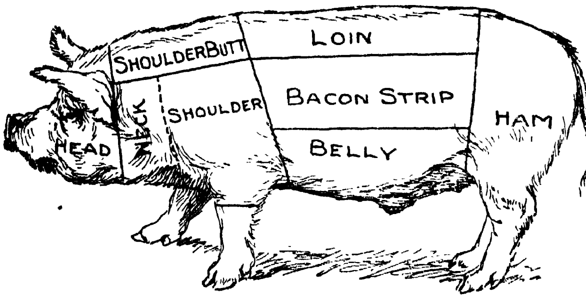


Fig. 290. Utilizing pork. Head, head-cheese, sausage, bean-pork; shoulder butt: roast, steak, butt-fat; shoulder: steak, picnic ham, roast; loin: fat back, tenderloin, roast, chops; bacon strip: bacon, salt pork; belly: salt pork; ham: cured ham, steak; feet: pickled pig's feet

to be had. It is also less trouble to pack the meat in a barrel and pour on a brine than to go over it three or four times to rub in the salt. The brining method also gives better protection from insects and vermin. Trouble is sometimes experienced in keeping brine, but if pure water is used and directions followed in making the brine, there should be no difficulty in keeping it for a reasonable length of time. In warm weather, brine should be closely watched. If it becomes "ropy," like syrup, it should be boiled or a new brine made. A cool, moist cellar is the best place for brine-curing. Dry-curing may be done successfully in a cellar also, although even more moisture is needed to effect a thorough cure. The cellar should be dark and tight enough to prevent flies and vermin damaging the meat.

Recipes for curing.[1]

Corned beef.—The pieces commonly used for corning are the plate, rump, cross-ribs, and brisket, or in other words, the cheaper cuts of meat. The loin, ribs, and other fancy cuts are more often used fresh, and since there is more or less waste of nutrients in corning, this is well. The pieces for corning should be cut into convenient-sized joints, say five or six inches square. It should be the aim to cut them all about the same thickness so that they will make an even layer in the barrel.

Meat from fat animals makes choicer corned beef than that from poor animals. When the meat is thoroughly cooled it should be corned as soon as possible, as any decay in the meat is likely to spoil the brine during the corning process. Under no circumstances should the meat be brined while it is frozen. Weigh out the meat and allow eight pounds of salt to each 100 pounds; sprinkle a layer of salt one-quarter of an inch in depth over the bottom of the barrel; pack in as closely as possible the cuts of meat, making a layer five or six inches in thickness; then put on a layer of salt, following that with another layer of meat; repeat until the meat and salt have all been packed in the barrel, care being used to reserve salt enough for a good layer over the top. After the package has stood over night add, for every 100 pounds of meat, four pounds of sugar, two ounces of baking soda, and four ounces of saltpeter dissolved in a gallon of tepid water. Three gallons more of water should be sufficient to cover this quantity. In case more or less than 100 pounds of meat is to be corned, make the brine in the proportion given. A loose board cover, weighted down with a heavy stone or piece of iron, should be put on the meat to keep all of it under the brine. In case any should project, rust would start and the brine would spoil in a short time.

It is not necessary to boil the brine except in warm weather. If the meat has been corned during the winter and must be kept into the summer season, it would be well to watch the brine closely during the spring, as it is apparently more likely to spoil than at any other season. If the brine appears to be ropy or does not drip freely from the finger when immersed and lifted, it should be turned off and new brine added, after carefully washing the meat. The sugar or molasses in the brine has a tendency to ferment, and, unless the brine is kept in a cool place, there is sometimes trouble from this source. The meat should be kept

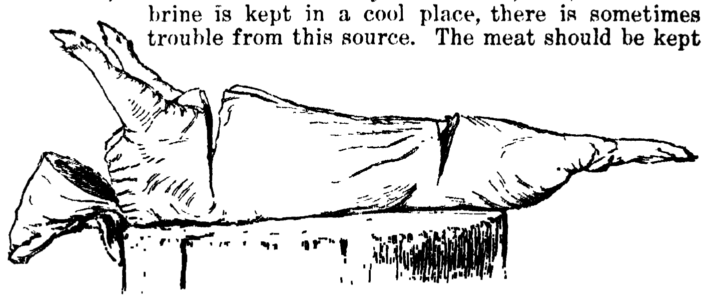


Fig. 291. The cuts of pork. Head, shoulders, middle and hams.

in the brine twenty-eight to forty days to secure thorough corning.

Dried beef.—The round is commonly used for dried beef, the inside of the thigh being considered the choicest piece, as it is slightly more tender than the outside of the round. The round should be

[1] Saltpeter in small quantities is included in these recipes because its use has heretofore been customary. Inasmuch as it is objected to by some hygienists as being injurious to health, and is thought to be useful only for preserving or adding color, it is considered advisable to make experiments to see whether this ingredient can not be dispensed with.

cut lengthwise of the grain of the meat in preparing for dried beef, so that the muscle fibers may be cut cross-wise when the dried beef is sliced for table use. A tight jar or cask is necessary for curing. The process is as follows: To each 100 pounds of meat weigh out five pounds of salt, three pounds of granulated sugar, and two ounces of saltpeter; mix thoroughly together. Rub the meat on all surfaces with a third of the mixture and pack it in the jar as tightly as possible. Allow it to remain three days, when it should be removed and rubbed again with another third of the mixture. In repacking, put at the bottom the pieces that were on top the first time. Let stand for three days, when they should be removed and rubbed with the remaining third of the mixture and allowed to stand for three days more. The meat is then ready to be removed from the pickle. The liquid forming in the jars should not be removed, but the meat should be repacked in the liquid each time. After being removed from the pickle the meat should be smoked and hung in a dry attic or near the kitchen fire where the water will evaporate from it. It may be used at any time after smoking, although the longer it hangs in the dry atmosphere the drier it will get. The drier the climate, in general, the more easily meats can be dried. In arid regions, good dried meat can be made by exposing it fresh to the air, with protection from flies.

Plain salt pork.—Rub each piece of meat with fine common salt and pack closely in a barrel. Let it stand over night. The next day weigh out ten pounds of salt and two ounces of saltpeter to each 100 pounds of meat and dissolve in four gallons of boiling water. Pour this brine over the meat when cold, cover and weight down to keep it under the brine. Meat will pack best if cut into pieces about six inches square. The pork should be kept in the brine till used.

Sugar-cured hams and bacon.—When the meat is cooled, rub each piece with salt and allow it to drain over night. Then pack it in a barrel with the hams and shoulders in the bottom, using the strips of bacon to fill in between or to put on top. Weigh out for each 100 pounds of meat, eight pounds of salt, two pounds of brown sugar, and two ounces of saltpeter. Dissolve all in four gallons of water, and cover the meat with the brine. For summer use it will be safest to boil the brine before using. In that case it should be thoroughly cooled before it is used. For winter curing it is not necessary to boil the brine. Bacon strips should remain in this brine four to six weeks; hams six to eight weeks. This is a standard recipe and has given the best of satisfaction. Hams and bacon cured in the spring will keep right through the summer after they are smoked. The meat will be sweet and palatable if it is properly smoked, and the flavor will be good.

Dry-cured pork.—For each 100 pounds of meat weigh out five pounds of salt, two pounds of granulated sugar, and two ounces of saltpeter, and mix them thoroughly. Rub the meat once every three days with a third of the mixture. While the meat is curing it is best to have it packed in a barrel or tight box. For the sake of convenience it is advisable to have two barrels, and to transfer the meat from one to the other each time it is rubbed. After the last rubbing the meat should lie in the barrel for a week or ten days, when it will be cured and ready to smoke. To cure nicely it is desirable to have a cool and rather moist place in which to keep it.

This recipe should not be used when the meat must be kept in a warm and dry place, as the preservatives will not penetrate easily and uniformly.

Head-cheese.—Cut a hog's head into four pieces. Remove the brain, ears, skin, snout and eyes. Cut off the fattest parts for lard. Put the lean and bony parts to soak over night in cold water in order to extract the blood and dirt. When the head is cleaned put it over the fire to boil, using water enough to cover it. Boil until the meat separates readily from the bone. Then remove it from the fire and pick out all the bones. Drain off the liquor, saving a part of it for future use. Chop the meat up finely with a chopping knife. Return it to the kettle and pour on enough of the liquor to cover the meat. Let it boil slowly for fifteen minutes to a half hour. Season to taste with salt and pepper just before removing it from the fire. Turn it into a shallow pan or dish. Cover with a piece of cheesecloth and put on a board with a weight to make it solid. When cold it should be sliced thinly and served without further cooking.

Scrapple.—This article of food is made just as head-cheese is until the bones are removed and the meat chopped, when the liquor is added and the dish returned to the stove to boil. Corn-meal is then stirred in until the contents are as thick as cornmeal mush. Stir it constantly for the first fifteen minutes, then set it back on the stove to boil slowly for an hour. When it is done pour it into a shallow dish to mold. When cold it is sliced thin and fried.

Souse.—Soak the pig's feet, ears and snout for twelve hours in cold water. Scrape them clean and remove the toes. Boil until soft; four to five hours will usually be required. Salt them when partially done. Pack in a stone jar and cover with hot, spiced vinegar. Souse is served cold or fried in a batter made of eggs, flour, milk and butter.

Trying-out lard.—Only the best of fat should be used for choice lard. Leaf-fat is the best. The back strip of the side also makes good lard, as do the ham, shoulder and neck trimmings. Gut-fat should never be mixed with the leaf- and back-fat. It makes a strong-smelling lard and should be kept separate. All scraps of lean meat should be cut out of the fat before trying-out, as they are very likely to stick to the kettle and get scorched, giving an unpleasant flavor to the lard. When preparing the fat for trying, cut it into pieces one to one and one-half inches square. They should be nearly equal in size, so that they will try-out in about the same time. Fill a clean kettle about three-fourths full and put in a quart of water, or, if convenient, a quart of hot lard. One or the other is necessary to prevent the fat burning before the heat is sufficient

to bring out the grease. Keep the kettle over a moderate fire until the cracklings are brown and light enough to float. Frequent stirring will be necessary to prevent burning. When done remove from the stove and allow to cool slightly, and then strain through a muslin cloth into a large jar. Stir it occasionally until it is cool enough to begin to solidify. If pails or smaller jars are to be filled the lard should be dipped out while just warm enough to be liquid. Stirring while the lard is cooling tends to whiten it and make it smoother. A quarter of a pound of saleratus added to each 100 pounds of fat has a like effect.

Sausage.—Pork sausage should be made only from clean, fresh pork. To each three pounds of lean pork add one pound of fat. As the pork usually used for sausage is the shoulder, neck and lean trimmings the sausage is likely to be too fat unless part of the fat is removed and used for lard. Mix the fat and lean meat together in chopping. When a rotary cutter is used it is best to cut the meat twice. After it is cut the first time spread it out thinly and season. One ounce of pure, fine salt, one-half ounce of ground black pepper, and one-half ounce of pure leaf-sage, rubbed fine, to each four pounds of meat, will suit the taste of most persons. The seasoning should be sprinkled thinly over the cut meat and the meat again run through the cutter to mix the seasoning thoroughly. This method will give a more even mixing of the spices than can be secured by working it with the hands. For immediate use the sausage may be packed away in stone jars or crocks, to be sliced for frying. Many persons stuff it into casings made from the small intestines of the hog. When this is done the intestines must be turned inside out and carefully cleaned.

Casings for sausage can be bought for about three cents per pound. At this price it will hardly pay to bother cleaning them for home use. The bought casings are more uniform in size and strength, and will usually give better satisfaction. A good substitute for casings may be had in narrow muslin bags. These, when filled, should be two and one-half or three inches in diameter and eighteen to twenty-four inches long. Stuff in the sausage tightly by hand and hang in a cool place. If the sausage is to be kept for some time, melted lard should be rubbed over the outside of the bag. This excludes the air. Sausage may be kept for some time in a large jar if a thin coat of lard is put over the top.

Mixed sausage may be made from a mixture of pork and beef in almost any proportion. It is the custom on many farms to kill three or four hogs and a beef during the winter for the year's supply of meat. When this practice is followed a good supply of sausage can be made from the trimmings. Sausage should not contain too much fat. A good proportion is two pounds of lean pork, one pound of fat pork, and one pound of lean beef. Chop together fine and season the same as pork sausage. Pack in jars, muslin bags or casings. Many persons prefer this to clear pork sausage, as it is not so fat.

Hamburg steak.—This is made from lean beef by running it through a sausage cutter. A very little fat should be added to the lean beef to make it juicy. It should be run through the cutter twice before using and salted slightly. A small amount of sugar-cured bacon is sometimes cut in with the beef to add flavor. Lean beef from the round makes the choicest Hamburg, but neck pieces, flanks, and trimmings are frequently used. Hamburg steak is not stuffed into casings, but is left in bulk and made into patties for frying.

Bologna sausage.—To each ten pounds of lean beef use one pound of fat pork, or bacon if preferred. Chop fine and season with one ounce of salt to each four pounds of meat, one ounce of the best black pepper (ground, pure) to each six pounds of meat, and a little ground coriander. Stuff into casings called beef "middles" or beef "rounds." If stuffed into middles, make the sausages ten or twelve inches long and allow them to hang straight. If stuffed into rounds, make them twelve to fifteen inches long and tie the ends together so as to form rings. Smoke for ten or twelve hours. Cook in boiling water until the sausages float, dry on clean hay or straw in the sun, and hang away in a cool place until wanted.

Casings.—Sausage casings are the intestines of hogs, cattle, or sheep, which have been emptied and cleaned. They are turned inside out and soaked in a solution of lye or limewater, thoroughly washed and salted. When cleaned and put up by a reputable packer they are as good as when cleaned at home, and when they can be bought at a reasonable price, it hardly pays to clean them for home use. The casings from different animals are used for the various kinds of sausages. Beef casings are of three kinds: "rounds," made from the small intestines; "bungs," made from the large intestines; and "middles," made from that part of the entrails leading from the bung to the rectum. The "rounds" are used for bologna, the "bungs" for bologna, ham, and blood sausage, and the "middles" for bologna and summer sausage. Hog casings are made from the small intestines, and are used mainly for common pork link-sausage. Sheep casings are from the small intestines, and are commonly used for wienerwurst and other small kinds of sausages.

Smoking of meats.

Pickled and cured meats are smoked to aid in their preservation and to give flavor and palatability. The creosote formed by the combustion of the wood closes the pores, to some extent excluding the air, and is objectionable to insects.

House and fuel. The smoke-house should be eight or ten feet high to give the best results, and of a size suited to the quantity of meat likely to be smoked. Ample ventilation should be provided to carry off the warm air in order to prevent overheating the meat. A fire-pot outside of the house proper with a flue through which the smoke may be conducted to the meat chamber gives the best conditions for smoking. When this cannot well be arranged, a fire may be built on the floor of the house, and the meat shielded by a sheet of metal.

When the meat can be hung six or seven feet above the fire, this precaution need not be taken. The construction should be such as to allow the smoke to pass up freely over the meat and out of the house, though rapid circulation is at the expense of fuel.

The best fuel for smoking meats is green hickory or maple wood smothered with sawdust of the same material. Hard wood of any kind is preferable to soft wood. Resinous woods should never be used, as they are likely to impart bad flavors to the product. Corn-cobs are the best substitute for hard wood and may be used if desired. Soft wood and corn-cobs give off large amounts of carbon in burning, and this is deposited on the meat, making it dark in color and rank flavored. Juniper berries and fragrant woods are sometimes added to flavor the meat.

Filling the house.—Meat that is to be smoked should be removed from the brine two or three days before being put in the smoke-house. If it has been cured in a strong brine, it will be best to soak the pieces in cold water over night, to prevent a crust of salt forming on the outside when drained. Washing the meat in tepid water and scrubbing clean with a brush is a good practice. The pieces should then be hung up to drain for a day or two. When drained they may be hung in the house. All should be suspended below the ventilators and should hang so that no two pieces come in contact, as this would prevent uniform smoking.

Keeping up the fire.—A slow fire may then be started, warming the meat gradually. In the winter months in cold climates, it is best to keep the fire going continually until the smoking is complete, holding the temperature at about the same point. If the fire is allowed to die down, the meat becomes cold and the smoke does not penetrate readily. This results in heavy smoke on the outside, and very little on the inner parts of the meat. In the spring months, and in the summer, a light fire may be started every day for a couple of weeks, the meat being allowed to hang in the smoke-house until sufficiently colored. When the fire is kept going steadily, and an even temperature is maintained, twenty-four to thirty-six hours will be required to finish one lot of meat. Smoke will not penetrate frozen meat, and it will be necessary to extract all frost from it before filling the house. The house should be kept dark at all times to prevent flies entering. As soon as smoked sufficiently, the meat should be cooled by opening the ventilators or doors. When hard and firm it may be canvassed or packed away for summer use.

Storage and refrigeration.

It is almost impossible to get the best conditions for storing meat under farm equipment. A knowledge of the best principles of storing, however, may aid in securing good keeping qualities in the meat. It is important that the carcass be cooled soon after slaughtering. The temperature should be such that the meat does not freeze. While it is impossible to control the temperature in most farm buildings, it is possible to slaughter when the weather is favorable properly to cool the meat. The most desirable temperature for cooling meat is just above freezing, and any reasonable approach to this temperature will give good results. Very often, a cool, dark room in the barn or granary can be made to answer the purpose, athough when a considerable quantity of meat is to be handled, it is better to provide a place especially for the purpose. For the best results in cooling, the air should be dry as well as of a low temperature. Free circulation aids greatly in carrying away foul odors and mold spores. Flies and other insects should be kept away from the meat.

Beef and mutton, if fat, may be kept for three or four weeks at a temperature of 34° to 40°, if the atmosphere is dry. The texture of the meat is somewhat improved in the curing process. Pork and veal, on the other hand, will keep for only a short time and should be used fresh, if possible. The meat will keep longer in large pieces, and it is best not to cut the carcass until the parts are wanted, unless there is danger of freezing, which would prevent cutting as wanted.

Cold-storage of cut pieces.— It is difficult to keep the cut pieces of meat fresh during the summer months without the use of ice, and even then but little can be handled at one time under farm conditions. When a room can be kept at a temperature of forty degrees or less with good ventilation, fresh meat may be kept for a week or ten days. It is important that the circulation be free and the air dry. Moisture in a refrigerator tends to develop wet mold or slime, and the decay will contaminate any meat in the refrigerator. A high temperature and dry atmosphere is preferable to a low temperature with damp air. For ordinary purposes, the best facilities for storing fresh meat will be afforded in a small ice-house built for the purpose with a storage chamber, well protected on the south side. By packing the ice properly on three sides, leaving the fourth side for entrance, a very effective and convenient cold-storage house may be made. In addition, the room can be used, if wanted, for storing butter, eggs and other perishable products. Good drainage should be provided and ventilation allowed for the escape of warm air which will gather in the top of the refrigerator.

In the North much meat is kept during the cold season by freezing. A carcass may be cut into quarters or smaller pieces and hung in an outbuilding in which it will remain frozen. When a part is wanted, it may be cut off with a saw. The freezing injures the flavor but little, provided alternate freezing and thawing is not allowed. The preferable method, however, is to cut the pieces into marketable-sized joints, freeze them and pack them in snow that is cold enough to be dry. Meat thus packed and kept in a room where the temperature is uniform and below the freezing point, will keep for a long time. This method of refrigeration is applicable only to localities where snow and continued dry, cold weather prevail during the winter months.

Another method of preserving meat that is often resorted to is that of partially cooking and pack-

ing the pieces in large jars, covering with hot lard. As the meat is needed for use, it may be removed from the jar and recooked. It is better to use several small jars for this purpose than one large one, as only a part of the meat need be disturbed at once. The jar containing the partially cooked meat should be kept in a cool, dark cellar to insure safe keeping.

Ammonia refrigeration.— The modern packing-house or meat-shop is usually equipped with an ammonia refrigeration plant. This process, however, is too expensive and elaborate to be of use on the ordinary farm and, therefore, it is not discussed under this subject.

Rendering tallow.

Tallow is composed largely of the fats from the bodies of cattle and sheep. Previous to 1871 it was used largely for soap stock and, in a limited way, in the manufacture of candles for illuminating purposes. Since that time it has become valuable in the manufacture of edible compounds and has outgrown its former use.

In small slaughter-houses or with home-dressed animals no separation of the fats is made. All are thrown together and sold as "rough tallow" or are rendered in an open kettle and sold as "cake tallow." When a nice brand of cake tallow is desired, care should be used to select only the choicer parts of the fat that have been kept clean and that are free from the lean parts of meat. Frequent stirring and a slow, steady fire are necessary to prevent scorching the fat, which would result in a highly-colored tallow with strong flavor. Hashing the rough tallow finely aids in the free and rapid extraction of the fat.

In rendering tallow in a large slaughtering establishment, the rough tallow is carefully sorted. That converted into oleo-oil — a product used extensively in the manufacture of oleomargarine, butterine and other similar edible products — must be kept clean and uncontaminated and rendered at a low temperature in a steam-jacketed kettle. Even of the oleo-oils two or three grades are made, depending on the quality of fats used and the conditions under which they are rendered. The residue and skimmings from the oleo-oil extraction are used with the poorer quality of fats in making ordinary beef tallow, which is used for grease, soap and machine-oils. Such tallow is rendered in steam-jacketed kettles under forty pounds of steam pressure or a temperature of about 280° Fahr. For No. 1 oleo-oil, caul fat, brisket and crotch trimmings, paunch, pluck and heart trimmings are used. For No. 2 oleo-oil, poorer grades of these same fats with bed-fat and kidney trimmings are used. Such fats give a more highly-flavored oil.

Soap-making.

Soap is of two general classes: soft soaps, made with potash as the alkali, and hard soaps, in which soda, ammonia and other alkalies form the base.

The raw materials used in soap-making are animal and vegetable fats, such as beef tallow, hog fats, cottonseed oil, coconut oil and rosin, in combination with caustic soda in chemical combination and soda ash and silicate of soda in mechanical mixtures. Grades of fat are used ordinarily that are inferior or unfit for the manufacture of edible products. Grease of any kind may be used for making the lower grades of soap.

As ordinarily made for farm use, soft soap consists of the accumulation of fat and grease from various sources, combined with lye secured through leaching hardwood ashes or from commercial sources. The fat is placed in a large open kettle, the alkali added as leached, and when in proper proportions, as estimated by the consumption of the fat by the alkali, the mixture is boiled until of the desired consistency. The hard soaps are made in much the same way as the soft kinds, except that the soda salts are used as the alkali instead of the potash lye from the ashes or other sources. Rain-water is often added to the liquid when the lye is too strong, and salt or "brine pickle" is used to separate the soap and clarify the precipitate.

The manufacture of commercial soap is based on the same principles of chemical action, but is vastly more complicated because of the numerous kinds of soap made and the various forms of fats, oils and lyes used.

Making candles.

The term, "candles," as commonly used is meant to indicate cylinders of wax, fat, or other fusible and combustible material surrounding a combustible wick. Candles were used originally for illuminating purposes, but at the present time largely for decorative purposes and religious symbols, although some are still used for illumination.

The materials used for candles are hard palmitic and stearic acids of animal fats, hydrocarbons, such as paraffin, ozokerite, or earth-wax and esters of the fatty acids of tallow and waxes. Paraffin is secured from petroleum, and has grown strongly in favor for use in candle-making because of its illuminating power and freedom from smoke and odor. It has a low melting point, however, and is improved greatly by the addition of 10 to 15 per cent of stearic acid, which makes a harder candle. Ozokerite is an earth-wax, varying in hardness from a soft material to a material as hard as gypsum, and in color from yellow to black. Candles made from ozokerite are of greater illuminating power than those from paraffin, and of a higher melting point. Beeswax is also used for making a high grade of candles that are free from smoke and odor. Beef tallow is used for the poor grades of candles, but its use in the pure form has been largely discontinued. The fats and waxes used for candles are colored in any shade desired by the use of aniline dyes.

The essentials for good candle stock are that it will burn freely without odor or smoke, that it will not soften or lose its shape at warm temperatures or from the heat of its own flame, and that its melted fluid must be capable of being drawn up through the wick by capillary action.

There are three methods in general use for candle-making: (1) Dipped candles, made by dipping the wick in melted stock repeatedly, each layer being allowed to harden and cool before being dipped again. (2) Poured candles, made by pouring the melted stock over the wick, which is stretched in a frame. Wax candles are chiefly made in this way, and are given shape while still plastic by rolling over a smooth surface to make them uniform in size and shape. (3) Molded candles. The most common method of making candles is to pour the melted stock into cylindrical metal forms or molds in which the wick has been drawn or threaded. This gives a candle of uniform size and shape.

The wicks are made of cotton, carefully spun so that the threads are even. The size varies with the size of the candle to be made.

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SHIPPING MEAT AND HIDES

By *W. H. Tomhave*

Too much stress cannot be laid on the importance of properly preparing meat products for shipping and of care in shipment. Losses and deterioration from neglect in this phase of the work need not be experienced.

Dressed beef carcasses.—Nearly all the shipping of dressed-beef carcasses is done by the packer. He ships the beef either direct to the butcher or to the wholesale distributing houses. Farmers have no need for dressing their own cattle and shipping the carcasses, as they can realize more for their stock by shipping it alive. When carcasses are to be shipped, they are usually quartered so that they may be handled with ease. They are hung in refrigerator cars made expressly for this purpose. Near the ceiling of the car are a number of cross-bars, with hooks, on which the quarters are hung. At each end of the car is an ice-box that is filled with ice when the car is loaded, so as to keep the meat from spoiling while on the road. If only a few carcasses are to be shipped they should be wrapped in burlap, so as to keep them clean while on the road and while being handled. If hearts, livers, tongues, or other minor products are to be shipped in the same car, they are usually put on racks on the floor of the car.

Sheep carcasses, when shipped in large quantities, are handled the same as beef. If only a few carcasses are shipped, they are sent by express. When this is done care must be taken to have them well wrapped with burlap, so as to keep them clean.

Hog carcasses are seldom shipped before they are cut up. The reason for this is that pork will spoil much quicker than beef and mutton, and most of the pork is cured by the packer or farmer. Hog carcasses are cut up into wholesale cuts, and only the loin and shoulder butts are shipped as fresh meat. In some cases, when there is a strong demand for fresh pork, shoulders are included in this list. These are packed in boxes or barrels which will hold fifty, one hundred, or two hundred pounds. The meat is usually wrapped in paper before it is packed. During warm weather crushed ice is put in the boxes to preserve the meat.

Smoked hams, bacon and shoulders are shipped by both packer and farmer. The essential factor in shipping smoked meat is to handle it as little as possible. Smoked meats are packed in boxes or barrels of convenient size. If care is taken in packing them it is not necessary to wrap them in paper or burlap. Very choice hams and bacon are wrapped in paper and covered with burlap, or are wrapped in paper and muslin and covered with a coat of white-wash. Smoked meats should be shipped by freight, as there is no danger of spoiling and the cost is not nearly so great as when shipped by express. Corned-beef is usually put up in kegs or barrels and shipped by freight.

Lard is usually put up for shipment in fifty-pound cans. It may be put up in smaller cans or stone jars, but the jars are usually too heavy or too expensive. The cans are shipped in frames made of wood. These frames are made by taking four pieces of wood the length of the can, making a four-cornered frame of the proper size and putting cross-pieces on both ends to protect the can and to keep the cover on. Unless shipped in large quantity, the shipping directions are put on the crate, which is shipped either by express or by freight.

Veal is probably as important to the farmer as any other meat product. Much veal is shipped, especially in the northern states. As soon as the veal is dressed, and all internal organs, except the liver, are removed, the carcass should be thoroughly cooled. The pieces of hide from which the head and shanks have been removed should be folded up and tied so as to prevent dirt and dust from accumulating. The cut which was made through the mid-line in removing the internal organs should be drawn together in some way to keep the inside clean. This can be done by tying the sides together or by wrapping the carcass with burlap. If possible, veal should be shipped so as to reach the commission man in the morning. The shipping-tag should be firmly attached and shipment made by express.

Beef hides.—In preparing beef hides for shipment they should be well salted, except during the winter months, when they may be shipped frozen. The salt must be put on in an even layer on the inside.

The hide should be rolled up tight and tied so that it will not come apart when handled. The shipping-tag may be fastened to the cord used in tying the hide and the hide shipped by freight.

Sheep pelts are prepared for shipment in a different way than beef hides. They are put up in packs of about a dozen each. In making a pack, put the first pelt with the wool side down. Continue in this manner until the pack is large enough. Then tie with heavy cord and ship the same as beef hides. Wool is shipped in large sacks made out of burlap. Each fleece is tied in a bundle and packed in the sack closely. These woolsacks can be secured from hide and wool companies on application. Wool is shipped by freight.

Poultry is shipped both alive and dressed, depending on the time of the year shipment is made. It is better to ship poultry alive during the summer months, as there is less danger of loss in transit. If poultry is to be shipped dressed, it is necessary to keep the fowls off feed for twenty-four hours, or more, to empty the craw and intestines, so that decomposition will not take place so rapidly. The fowl should be bled by sticking in the roof of the mouth or through the neck below the ear. The head should not be removed, as that detracts from the appearance of the fowl and makes a loss of weight. The feet are also left on for appearance and additional weight. Poultry dressed for market should not be drawn.

The poultry should be packed in a box or barrel of convenient size. The head should be wrapped with paper, which will absorb the blood. In packing the first layer in the bottom the fowls should be put in so as to have the breasts down and the heads folded to one side. They are thus put in until the top layer is reached, which should be packed with the breasts up, so that if the box or barrel is opened on either end the first layer will give a presentable appearance. If poultry are shipped alive, they should be placed in crates made of wooden strips. Crates of convenient size are made about forty-two inches wide, fifty-four inches long and eighteen to twenty inches deep. A crate of this size will hold about one hundred and twenty-five to one hundred and fifty pounds of live fowls. The strips should be nailed about two inches apart, making the crate as light as possible. Both dressed and live poultry should be shipped by express, so as to avoid being on the road any length of time. Empty crates can always be returned at a cost of ten or fifteen cents.

THE CANNING OF MEAT AND FISH

By *W. D. Richardson*

Inasmuch as microörganisms (and chiefly bacteria) are the principal exciting cause in the deterioration of flesh foods, any means which destroys bacteria or lessens their vitality and activity will lessen the deterioration. The following list includes all means which up to the present have been used to hinder or prevent the growth of bacteria in foods:

(1) Low temperatures (freezing stops bacterial growth entirely).
(2) Heat sterilization:
  a. Absolute.
  b. Partial (pasteurization).
(3) Dessication.
(4) Antiseptics (including salt, saltpeter, sugar, spices, vinegar and wood-smoke).
(5) Exclusion of air (may be practiced in connection with any of the foregoing).

In the canning of meats, only two of these means are made use of, namely, heat-sterilization and exclusion of air. However, some cured and smoked meats—meats preserved by the use of antiseptics—are canned; but in these cases, naturally, the canning is not the essential means of preservation.

Heat sterilization.

As applied to meats, this is based on the fact that the vegetative forms of microörganisms in the moist condition are killed at or below the temperature of boiling water (100° C.), and that spores in the moist condition are killed at a somewhat higher temperature (120° C. or below). The temperatures above 100° C., used in canning, are obtained by means of steam under pressure, 120° C., corresponding to saturated steam under a gauge pressure of one atmosphere, or 14.7 pounds. In the canning business, heat sterilization is known as "processing," and is conducted in autoclaves known as "retorts."

Exclusion of air.

Excluding air alone will not preserve food products completely, but inasmuch as all molds and most bacteria grow best in the presence of oxygen, its absence materially assists the keeping qualities of meats. Furthermore, oxygen is the active substance concerned in the production of those changes which occur in fats, and which are known collectively as rancidity. Hence, in the absence of air, rancidity, with its attendant disagreeable odor, will be avoided. All meats, even the leanest, contain some fat, and the prevention of rancidity is of great importance. Exclusion of air is practiced in connection with heat sterilization, and also in the canning of cured meats, as sliced dried beef, and sliced bacon, where heat sterilization is not made use of.

Gross composition of meat.

From the nutrition standpoint, meat—the flesh of warm-blooded animals—is composed of:

(1) Certain proteins which constitute the major portions of the muscle fiber proper.
(2) Collagen, in the connective tissue surrounding the muscle fibers, and in the fatty tissue and bone.
(3) Organic extractive matters, principally nitrogenous, which latter are classified under the name meat bases.
(4) Mineral salts.
(5) Fats.

The characteristic flavor of meat is due to the extractive matters, the mineral salts, and in the case of meat from some animals (such as sheep and goats), to certain fatty substances.

Effect of water on meat, and the theory of cooking.

The effect of water on meat, and the theory of cooking must be dealt with briefly. The effect of cold water on meat is to extract the soluble salts, the meat bases and some of the proteins. The amount of solid matter thus possible to extract from lean beef amounts to about 6 per cent. The effect of boiling water is to shrink the bulk of the meat by coagulating the proteins, to hydrolyze the collagen of the connective tissue, thus producing gelatin, which passes into solution, and to dissolve salts and meat bases. Long-continued boiling causes hydrolysis of more or less of the meat proteins, which pass into solution in the form of albumoses. In roasting, boiling, frying, and in those cooking processes in which water is not used, the effects are in general the same as in boiling (for meat contains 70-75 per cent of water), excepting that the salts and meat bases and proteins are for the most part retained.

Meat-canning.

The details of the methods of different packers differ to a slight extent, although the principles are in all cases essentially the same, and these details will not be entered into. The descriptions of the practical methods, follow the lines of general or most approved practice. The patented method of canning meats, which came into general use a few years ago, and which consisted in sealing the filled cans in vacuo, and conducting them on an endless chain, first through a bath of molten paraffin, heated to the proper temperature, and then through a solution of sodium carbonate (to remove the grease), appears to be going out of use.

All meat-canning establishments that do an interstate business are operated subject to the supervision of a United States government inspector and his assistants. In this way the public is assured that meats are sound and wholesome.

The principal varieties of canned meats are canned roast beef or boiled beef, canned tongue, smoked meats (chipped dried beef, bacon, and the like), canned chicken and turkey, canned sausage and potted and deviled meats.

Canned roast beef.—Canned boiled or roast beef is made from lean meat derived for the most part from the fore-quarter of the animal. The meat is boned, cut into pieces weighing about one to four pounds and these are trimmed to remove fat and gristle. As a preliminary to canning these pieces are then parboiled for ten to thirty minutes, in order to shrink the meat. If this were not done, when the raw pieces were processed they would shrink in the cans, leaving the cans only partly filled with meat. The product would then present an indifferent appearance and the package would be less compact for a given weight of meat than when the preliminary parboiling was resorted to. After parboiling, the pieces are packed into cans of the desired size, sometimes by hand and sometimes by machine. It is desirable that the pieces in any one can be approximately of the same size in order that the processing may proceed uniformly. A certain quantity of the liquid resulting from the parboiling is now added to the cans and they are soldered up. The cans are next placed on circular trays made of woven wire and these are placed in the retorts, tier on tier, the top of the retort is clamped down, and the steam turned on. Each retort is provided with a steam gauge and thermometer in order that temperatures and pressures may be carefully controlled. The heating proceeds for one to two hours at temperatures of 218° to 230° Fahr., depending on the size of the cans and the practice of the factory. The cans are then removed from the retorts, a small vent made to release the enclosed air, and resoldered. The cans are returned to the retorts and reprocessed for one to two or more hours at temperatures of 235° to 255° Fahr., after which they are chilled, washed, lacquered and labeled. If the processing is properly carried out the cans will be sterile and free from air.

Canned corned beef is prepared from beef which has been "cured" or "corned" in a pickling brine containing salt, sugar and saltpeter. The process of canning is not essentially different from that employed in the case of boiled beef; the preliminary parboiling is continued for a somewhat longer time, and sometimes the water is twice changed and two boilings made in order to remove part of the salt taken up during the curing process. The processing may be accomplished at a lower temperature than that used for fresh beef, both because of the longer parboiling and the fact that it is more easily accomplished in the presence of salt than in its absence. In some factories a temperature not higher than the boiling-point of water is used. [See page 255.]

Canned tongue is prepared from the tongues of beeves, calves, sheep and hogs. The tongues are first pickled in a brine containing salt, sugar and saltpeter, and on removal from the pickling solution they are cooked one to two hours. After this they are trimmed and each tongue is rolled separately and placed in a circular can of the proper size. Instead of processing tongues in retorts, many houses prefer to heat the cans in brine to a temperature of 235° to 240° Fahr. Sometimes tongues are put up in glass cans with sheet-metal cover, the cover being set in place in a vacuum machine which first exhausts the air from the can. A rubber gasket around the rim of the can makes the package air-tight. Finally the cans are sterilized by heat in the usual way.

Canned smoked meats.—The principal canned smoked meats are sliced dried beef and sliced bacon. These are fully cured and smoked before canning, and therefore heat-sterilization is not necessary. They are packed in cans or jars of sheet metal or glass of various sizes, the air is exhausted in a vacuum machine and, in the case of tin cans, the vent is soldered while under vacuum. In the

case of sheet-metal covered glass jars the cover is adjusted in the vacuum machine and the package rendered air-tight by means of a rubber gasket.

Canned chicken and *turkey* are prepared from poultry which has been dressed and the carcass boiled until the meat separates easily. The meat is separated by hand, placed in cans and these are processed in a way similar to that employed for boiled beef.

Canned sausage.—A certain amount of sausage is placed in cans and processed. This sausage does not differ essentially from the cooked and smoked sausage sold without canning. Some sausage, particularly that known as bologna, is canned in oil. [See page 257.]

Potted meats.—Potted and deviled meats and patés are finely comminuted meats spiced and seasoned and processed. The list of preparations under this head is very large.

Canning of fish.

In general, the methods applied in the canning of fish are based on the same principles as those employed in meat-canning. Fish is a food which undergoes deterioration rapidly, the lean by bacterial decomposition and the fat in the presence of air because of the development of rancidity. Prompt and cleanly handling of the product is very essential in fish-canning establishments. Two instances only of fish-canning will be detailed here.

Salmon.—The salmon belong to the genus Onchorhynchus, of which five species are found on the western coast of America. They are taken by hook but chiefly by seines, transported to the canning factories as rapidly as possible, cleaned and scaled, and the heads, tails and fins removed. They are then allowed to stand a certain length of time in brine in tanks, after which they are drained, cut into pieces of the proper size and placed in cans. The space left in the cans is filled with salt brine, the cans sealed and autoclaved for one hour. The cans are removed, a vent made to release the air, resoldered and autoclaved again. They are removed from the autoclave, showered with cold water and lacquered and labeled.

Sardines.—The genuine sardine is found most abundantly along the coasts of France, Spain and Portugal. On the American side of the Atlantic, from Florida to Cuba, is found the Spanish sardine. Both of these belong to the herring family. Along the coast of Maine, small herring are put up for sardines. The fish are brought to the factory as quickly as possible and are immediately beheaded and eviscerated. They are then sprinkled with salt and drained on wooden slats over night. The next morning they are again salted, drained and dried. Following this comes the principal part of the process—cooking in oil. In the older process the fish were laid on pans, covered with olive-oil, and placed in the oven for five or six minutes. Then they were removed and drained on wire trays. In the more modern process they are laid on wire baskets, and dipped for the proper length of time in hot oil. The fish are laid in tin boxes as closely as possible, the boxes filled with olive-oil, closed and soldered, and cooked for one hour in water which is cold at the start, but which is boiled by means of injected steam. The so-called *shadines* are young menhaden.

Literature.

For a general discussion of the principles governing the preserving of perishable products by means of canning, and references to the literature of the subject, see Part II. of Vol. II.

MEAT. ITS NUTRITIVE VALUE, SELECTION AND PREPARATION

By *Flora Rose*

All life has its origin in a single cell. This is a minute mass of living substance, protoplasm, which possesses within itself all the vital powers,—activity, growth, assimilation, reproduction.

The simplest forms of living things are one-cell organisms which effect all their life processes independently. Each is a complete individual in its own right. All higher forms begin life in the same simple way as a single cell, independent at first, but growing and multiplying into a number of similar individuals, able to conduct many of their own vital processes, but dependent for ultimate existence on the organism they represent. As the body develops, groups of cells become specialized, some going to form skin and nervous system, others to form bone, muscles and circulatory system, still others to form the alimentary tract, liver, lungs, and other parts.

The body thus stands forth as an individual whole, but made up of countless lesser units. Its well-being depends on the well-being of its component parts. Health means good condition of the cells, as disease means disturbance of some cell group.

Some principles of nutrition.

The ultimate cell structure of the body points to the fact that the food problem is a cell problem. To feed the organism is to supply it with material that has the power of building up new cell tissue, or that will yield energy to the cell and thus to the body as a whole. The composition of cell substance is the first indication of cellular food needs. It always contains water, ash and substances known as proteids. Hence, for the growth and repair of active living tissue—protoplasm—the essentials are water, ash and proteid. Fats and carbohydrates, a group of substances the important food members of which are sugars and starches, also serve as a form of food for the cell. They are incapable by themselves of being built into protoplasmic tissue but are of greatest importance to the body, as it is chiefly from these that the cell derives energy for the manifestation of its various activities. They may be found as such within the cell as a stored form of energy derived directly from the fats and carbohydrates fed, or as a product of the metabolism of proteids.

To summarize: Proteids, though capable of yielding energy to the cell, have the further function of building living tissue. Carbohydrates and fats can be used directly in the body only as a source of energy, and when found as such in the body, are

stored there as a reserve form of food or fuel within the cell but not as a part of the protoplasm and not as living tissue.

Measure of nutritive value of food.

It has been found convenient to use the heat unit called Calorie as a measure of the nutritive value of foods. The Calorie is the amount of heat required to raise one kilogram of water one degree Centigrade of temperature. There are accurate methods of determining the amount of heat each of the substances, proteid, fat and carbohydrate, is capable of yielding to the body, and this amount is expressed in terms of the Calorie. Thus,

1 gram or .0022 pounds proteid yields 4 Cals.
1 gram or .0022 pounds carbohydrate yields 4 Cals.
1 gram or .0022 pounds fat yields 9 Cals.

A large and interesting literature has grown up in discussions of food requirements. It will be well to say in passing that for the normal man of average size at light muscular work, food yielding 2,400 to 3,000 Calories will be ample for a day's maintenance. Tigerstedt gives the following figures:

TABLE I.

2,000-2,400 Cals. for a shoemaker.
2,400–2,700 Cals. for a weaver.
2,700–3,200 Cals. for a carpenter.
3,200–4,100 Cals. for a farm laborer.
4,100-5,000 Cals. for an excavator.
Over 5,000 Cals. for a lumberman.

A certain proportion of this Calorie yield should be furnished by the protein of food, since there must be provision for wear and tear of tissue. There is much discussion and difference of opinion as to the proportion of protein the dietary should contain, and it is unwise to make definite statements in regard to this point within such limited space. However, it will not be radical to say that for food yielding 2,400 to 3,000 Calories, if 280 to 360 of the Calories are furnished by protein, there will be no protein deficit in the body. The following table gives the composition of some of the more common food materials.

TABLE II.—COMPOSITION OF SOME COMMON FOOD MATERIALS.

(Adapted from United States Department of Agriculture, Office of Experiment Stations, Bulletin No. 28)

Food material	Water	Protein	Fat	Carbo-hydrates	Ash	Fuel-value per lb
	Per cent	Per cent	Per cent	Per cent	Per cent	Calories
Beef	62.2	18.5	18.8	. .	.9	1,135
Veal	71.3	19.9	8.1	. .	1.0	735
Mutton	53.6	16.0	29.8	. .	.8	1,560
Lamb	58.2	17.6	23.1	. .	1.1	1,300
Pork	34.4	9.5	55.3	. .	.5	2,505
Fowls	63.7	19.2	16.3	. .	1.0	1,045
Hens' eggs, uncooked edible part	73.3	13.4	10.5	. .	1.0	720
Buttermilk	91.0	3.0	.5	4.8	.7	165
Cheese, American (pale)	31.6	28.8	35.9	.3	3.4	2,055
Cheese, Cottage	72.0	20.9	1.0	4.3	1.8	510
Milk, skimmed	90.5	3.4	.3	5.1	.7	170
Milk, whole	87.0	3.3	4.0	5.0	.7	325
Beans, dried	12.6	22.5	1.8	59.6	3.5	1,605
Peas, dried	9.5	24.6	1.0	62.0	2.9	1,655
Almonds, edible part	4.8	21.0	54.9	17.3	2.0	3,030
Peanuts, edible part	9.2	25.8	38.6	24.4	2.0	2,560
Walnuts, edible part	2.5	27.6	56.3	11.7	1.9	3,105
Corn-meal, granular	12.5	9.2	1.9	75.4	1.0	1,655
Corn-meal, unbolted	11.6	8.4	4.7	74.0	1.3	1,730
Oats, rolled	7.7	16.7	7.3	66.2	2.1	1,850
Rice	12.3	8.0	.3	79.0	.4	1,630
Wheat flour, entire wheat	11.4	13.8	1.9	71.9	1.0	1,675
Wheat flour, white	12.0	11.4	1.0	75.1	.5	1,650
Wheat flour, Graham	11.3	13.3	2.2	71.4	1.8	1,670
White bread	35.3	9.2	1.3	53.1	1.1	1,215
Beans, string, fresh, edible part	89.2	2.3	.3	7.4	.8	195
Cabbage, edible part	91.5	1.6	.3	5.6	1.0	145
Corn, green, edible part	75.4	3.1	1.1	19.7	.7	335
Onions, fresh, edible part	87.6	1.6	.3	9.9	.6	225
Peas, sugar, green, edible part	81.8	3.4	.4	13.7	.7	335
Potatoes, raw or fresh, edible part	78.3	2.2	.1	18.4	1.0	385
Spinach, fresh	92.3	2.1	.3	3.2	2.1	110
Apples, edible part	84.6	.4	.5	14.2	.3	290
Grapes, edible part	77.4	1.3	1.6	19.2	.5	450
Oranges, edible part	86.9	.8	.2	11.6	.5	240
Figs	18.8	4.3	.3	74.2	2.4	1,475
Prunes, edible part	22.3	2.1	. .	73.3	2.3	1,400
Raisins, edible part	14.6	2.6	3.3	76.1	3.4	1,605
Butter	11.0	1.0	85.0	. .	3.0	3,605

In interpreting the relation of nutritive value to food-needs, it must not be forgotten that some foods that have a relatively low fuel-value are of very great dietetic importance. For example, vegetables and fruits, although they are largely composed of water and give a low Calorie yield, are relatively rich in ash constituents, and the bulk they afford is of physiological value in promoting peristaltic action in the intestines and thus enabling the body more quickly to rid itself of its waste materials.

Protein in foods.

While most foods contain small amounts of proteids there are certain foods in which these substances predominate, and which are added to the dietary with deliberate intention of bringing up the protein ratio. These are mainly of animal origin, as meat, eggs, milk and cheese, although certain vegetable foods, such as dried beans and peas, nuts and some cereals, are also very rich in protein, and may be used as substitutes for the animal products. The protein food in most common use in this country is meat. A few figures taken from Grindley (Office of Experiment Stations, Bulletin No. 162) will show the importance placed on meat by the average American consumer: 37 per cent of the total expenditure on food is for meat; 38.2 per cent of the total protein, 58.9 per cent of the total fat and 18.5 per cent of the total nutrients of the diet are furnished by meat. As to the advisability of such free use of meat there is much diversity of opinion, and something may be said on both sides. There is no doubt that meat has a high food value, both because of its relatively large percentage of protein and because of a greater or less amount of fat.

Muscular structure.

Some understanding of the minute structure of muscular tissue is a material aid to the intelligent selection and preparation of meat products. In the development of the body, those cells which have gone to form muscle have become very much modified in character. They are elongated into tube-like structures known as muscle fibers, each fiber representing one muscle-cell. The cell-protoplasm is surrounded by a thin membranous wall, similar in composition, but materially different in characteristics and nutritive value to the cell contents. The muscle fibers are bound together into bundles by a network of connective tissue, and these fiber bundles are further bound together to form the muscle. In meat that has been boiled for a long time, it is easy to separate out the fiber bundles and note something of this structure.

Invisible droplets of fat may be found imbedded in the connective tissue, and in the flesh of many animals distinct layers of fat lie between the fiber bundles. Minute blood-vessels ramify through the connective tissue.

Composition and characteristics of muscle-substance.

Variations in the tenderness of meat and in the effects on it of cooking are due largely to differences in characteristics between cell content and connective tissue. As will be understood by the previous explanation, the muscle-fiber is largely composed of a watery solution of protein substances together with some ash. The greater part of these proteins is coagulated by heat and is insoluble in both cold and hot water. It is this characteristic coagulation which probably causes the hardening of meat in cooking. Prolonged high temperatures increase this hardening and give a tough, leathery character to the meat thus treated. Along with this insoluble coagulable proteid occur small amounts of soluble proteids and a group of substances known as meat extractives, which are soluble in both hot and cold water. It is to these extractives that meat probably owes its characteristic flavor.

Connective tissue and the membranous cell-wall become softened by the action of heat and water and, if the heating is long continued, they are changed into a soluble substance known as gelatin.

Careful note should be made of the above facts since they strike the keynote of successful cooking of meat products and explain some of the fallacies which hold with regard to the high nutritive value of broths and soup stocks.

Shortly after the death of an animal, the cell content undergoes a characteristic hardening known as *rigor mortis*, or the stiffening of death. This coagulation is due to some chemical change in the passing of tissue from a living to a lifeless state. After a certain number of hours, further change takes place, and the muscle grows softer as its proteids again become increasingly soluble. Meat used before *rigor mortis* has disappeared is relatively tough, hence the custom of "hanging" it.

Characteristics of good meat.

Meat should have uniformity of color and should be neither pale nor too purplish. There should be little or no odor to it. The flesh should be firm to touch and should neither pit nor crackle. On handling, it should scarcely moisten the fingers. There should be no evidence of parasites.

Beef should be bright red in color and should be marbled with fat.

Veal is paler and less firm than beef, but it should be of good, pinkish color and the meat should not be flabby nor the fat tallowy.

Mutton should be heavy and firm. The fat should be white, hard and clear, the flesh fine-grained and bright red in color. Poor mutton has little fat and relatively little flesh as compared with the amount of bone.

Lamb is less firm than mutton and the fat is softer, but it should be relatively firm.

Pork is the least firm of the meats and its fat is comparatively soft. The flesh should be of good color and the fat should be white and clear.

Tenderness in meat.

A small amount of delicate connective tissue, a thin cell-membrane, short fibers, and a time sufficient for the disappearance of *rigor mortis*, are the necessary conditions for tenderness in meat. A general rule for tender cuts of meat is, that the

least exercised and least exposed muscles are the most tender. Exercise and exposure tend to thicken the cell-wall and to increase and toughen the connective tissue. At the same time, the blood supply is increased and, as a rule, the tougher cuts are juicier and richer in flavor. Connective tissue is abundant and tough around the joints of any carcass, and cuts which include these parts may be undesirable for that reason. Tender meat is fine in grain and close in texture.

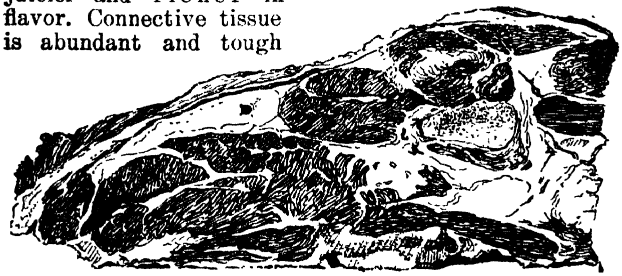

Fig. 292. The tenth cut rib.

A general rule is that the cut of meat increases in tenderness as the distance from either head or rump increases. Thus, those cuts coming from the loin and prime ribs are considered the choicest.

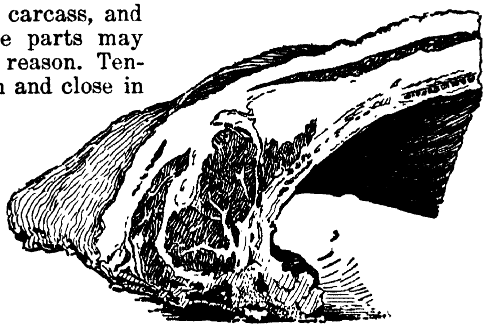

Fig. 293. The third cut rib.

The illustrations, Figs. 292–298, may serve to emphasize some of the above points. The cut in Fig. 292 is taken between the first rib and the shoulder-joint, and is the tenth cut rib. It illustrates the reason for toughness of meat at points near or surrounding a joint. The cut in Fig. 293 is between the eighth and ninth ribs, and is the third cut rib. It shows the increase of those characteristics marking tenderness in meat. Fig. 294 shows the second cut of the loin, the rump end of sirloin; Fig. 295, the seventh cut of sirloin, and Fig. 298, the thirteenth cut from the loin, known as tea-bone porterhouse steak. These last three figures show the changes in characteristics as the central cuts are reached from the rump end of the animal. Figs. 296, 297 illustrate the same points in cuts from the round; Fig. 297, fourth cut of the round, is the choicest cut in the round; Fig. 296, thirteenth cut of the round, marks the approach of the knee-joint and is the limit to which the round may be cut.

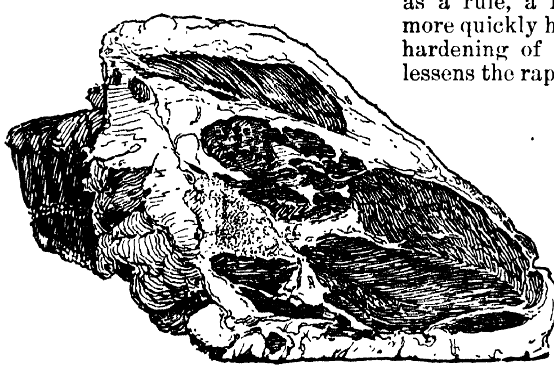

Fig. 294. The second cut of the loin

Underlying principles of meat cookery.

The main objects in cooking meat are: (1) to develop flavor and make it more palatable; (2) to make it more tender; (3) to kill any parasites that may occur in the meat. As has previously been explained, there are two opposing factors to consider in meat cookery: (1) the coagulation of the proteids by heat, and the possibility of its being rendered tough and leathery by high temperatures and too long-continued cooking; (2) the desirable softening effect of long-continued moist heat on the connective tissue. The proteid of meat begins to coagulate at a relatively low temperature, and at 175° Fahr., a temperature considerably below the boiling point of water, it is completely coagulated. It has been found that meat proteid subjected to a temperature of approximately 175° to 190° Fahr., while coagulated, is tender and friable, and if the temperature is maintained a sufficiently long time the connective tissue becomes soft and gelatinous. This, then, is the guide in marking the way to methods of preparation.

Methods of cooking.

One fact must not be overlooked in discussing methods of preparation, namely, that meat is a very poor conductor of heat, and that a long time may be required to bring the center of a piece of meat of any considerable size to the same temperature as the surrounding medium. Fat seems to permit heat to be conducted more rapidly, and, as a rule, a fat piece of meat is more quickly heated through. Quick hardening of the surface of meat lessens the rapidity with which heat passes to the center. This is seen in roasted meats, in which the surface is quickly browned and the interior of the meat is thus protected against the immediate effects of the high temperature. This condition is often sought in the cooking of roasts.

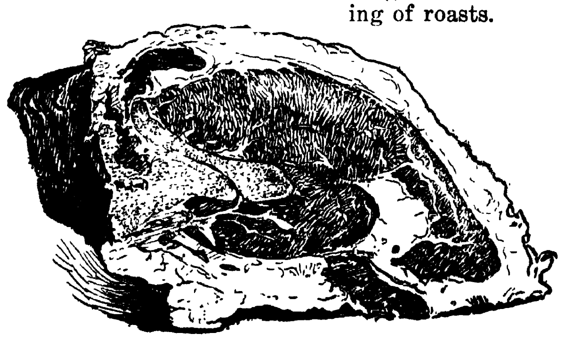

Fig. 295. The seventh cut of sirloin.

Quick processes.

With tender meats, no consideration of the softening of connective tissue is necessary. Development of flavor and increase in palatability are the main objects in their preparation. Tender cuts, therefore, are usually cooked by the quick processes, as broiling, pan-broiling, roasting, and the like. These methods of cooking require an initiative high temperature for a short time, and a subsequent lessening of heat to complete the change to the condition desired. Much of the failure of the housewife to secure good results in short-process cooking is due to an oversight of this important factor of lowered temperature, after the browned surface has been secured. The browned surface aids in retarding the entrance of heat to the innermost parts of the meat and the time required for cooking after the heat has been lowered will vary with the size, compactness, thickness and form of the meat, and with the amount of fat present. A few simple directions may be helpful in following out these processes.

Fig. 296. The thirteenth cut of the round, showing the point to which the round may be cut.

Broiling over a flame. — The meat should be thoroughly seared by bringing it in fairly close contact with the flame. After searing, the heat is lessened, both by holding the broiler farther from the flame, and by frequent turning. This factor of turning in broiling over direct flame, or in pan-broiling, is of first importance, as it distributes the heat evenly through the meat and prevents undue hardening. It retards evaporation and keeps in the juices, as every time the meat is turned the juices are sent from that side back toward the center of the meat. The time allowed must depend on the condition of "doneness" desired.

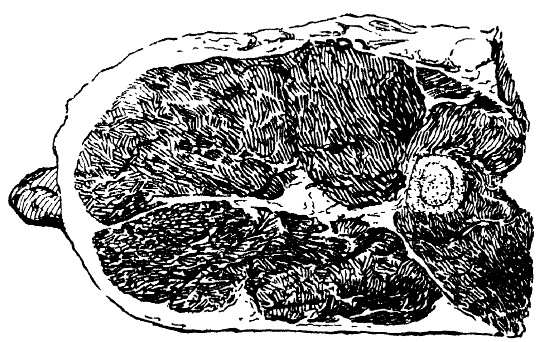

Fig. 297. The fourth cut of the round.

Pan-broiling. By this method, meat is cooked in a dry, hot pan without the use of any outside fat. The larger part of the fat of the meat is removed before cooking. The meat is thoroughly seared in the dry, hot pan, the heat is then lowered and cooking is continued at this lower temperature with almost constant turning. Meat cooked in this way has a flavor nearly equal to that cooked over a direct flame, and is superior in all ways to the old-fashioned so-called "fried" meat.

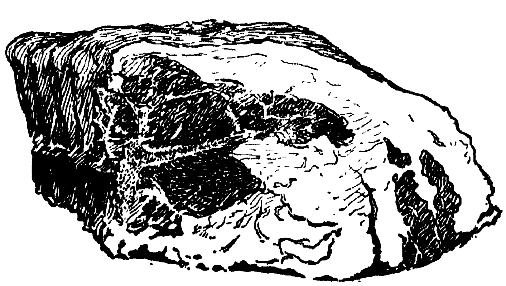

Fig. 298. The thirteenth cut from the loin, known as tea-bone porterhouse steak.

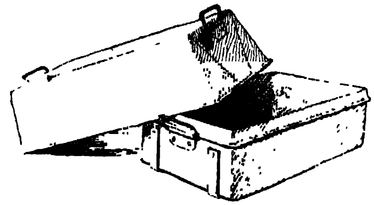

Fig. 299. A double roasting-pan.

Oven-roasting. — The roast should be put on a rack in the pan, skin side up, leaving both sides of the meat equally exposed to the action of the heat. The oven should be very hot for the first fifteen minutes, to sear and brown the roast, and then the heat should be lowered to the temperature required for the completion of the cooking. The temperature required for quick searing of an oven-roast is 480° Fahr. The temperature for the longer period of cooking may be as low as 212° Fahr., if sufficient time is allowed for the process. As a guide to the housekeeper it may be said that 480° Fahr. gives a very hot oven; 350° to 380° Fahr. is about the heat required to bake a medium-sized loaf of bread, if the heat is to continue one hour; 212° Fahr. is the temperature of boiling-water. The roast should be basted frequently with fat, a mixture of water and fat, or with its own juices, and this may be done from the outside or by the use of some such device as the double roasting-pan. (Fig. 299.)

The practiced housekeeper may be able to gauge oven-heat with a fair degree of accuracy, but for the novice an oven thermometer is an excellent guide, although not an infallible one. (Fig. 300.) Little thermometers to set inside the oven may also be used with good results.

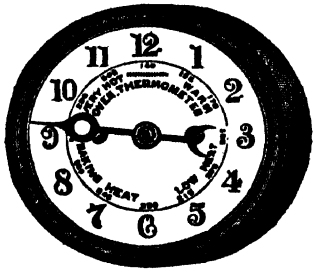

Fig. 300. An oven thermometer.

Some interesting work has been done by Elizabeth

Sprague and H. S. Grindley on "A Precise Method of Roasting Beef" (University Studies, Vol. II, No. 4, University of Illinois). The following table adapted from their publication may be of use to the interested housekeeper:

TABLE III.—TIME OF COOKING SINGLE SHORT-RIB ROASTS AND TWO-RIB ROLLED ROASTS

Kind of roast	Weight of roast		Temperature for first fifteen minutes	Temperature for remaining time	Total time of cooking		Time per pound	Condition of meat
	Pounds	Ounces	° Fahr.	° Fahr.	Hours	Min.	Minutes	
Single short-rib . .	4	4.25	480	380	1	10	16.3	Very rare
Single short-rib . .	4	2.75	480	380	1	20	19.2	Medium, verging on rare
Single short-rib . .	3	.25	480	380	1	25	28.2	Medium, verging on well-done
Single short-rib . .	3	5.00	480	380	1	40	30.4	Well-done
Two-rib rolled roast	4	11.64	480	380	1	35	20.1	Rare
Two-rib rolled roast	. .	. .	480	347	. .	. .	18.3	Rare
Two-rib rolled roast	. .	. .	480	212	. .	. .	38.5	Rare
Two-rib rolled roast	4	3.79	480	380	1	58	27.9	Medium-rare
Two-rib rolled roast	. .	. .	480	347	. .	. .	26.0	Medium-rare
Two-rib rolled roast	. .	. .	480	212	. .	. .	42.8	Medium-rare
Two-rib rolled roast	4	14.37	480	380	2	49	34.4	Well-done
Two-rib rolled roast	. .	. .	480	347	. .	. .	31.4	Well-done
Two-rib rolled roast	. .	. .	480	212	. .	. .	79.8	Well-done

In each of the above experiments, a slit was made in the roast, and a small chemical thermometer was inserted in such a way as to have the bulb of the thermometer at the center of the roast. The roast was then cooked at the usual preliminary temperature of 480° Fahr. for fifteen minutes. The subsequent temperature for the completion of the cooking was varied for three sets of experiments. In the first it was kept at 380° Fahr., in the second, at 347° Fahr., and in the third, at 212° Fahr. Some previous experiments had been made to show what temperature the center of the beef should reach to secure rare, medium-rare and well-done meat. These were as follows:

When meat was well-done, 158° to 176° Fahr.
When meat was medium-done, 149° to 158° Fahr.
When meat was rare, 130° to 149° Fahr.

In following out the experiment it was necessary only to watch the thermometer to know at what point the roast should be removed from the oven to secure the desired condition of rare, medium or well-done meat. The differences in conductivity of a single-rib roast and a compact, two-rib rolled roast of approximate weights are well illustrated by the variations shown in the time required to cook them. From the results of their experiments the authors conclude that the interior of the roasts cooked at the lowest temperature was more uniform, and although requiring a longer time for cooking there was less danger of overcooking by being in the oven a little over-long.

This illustration of the possibilities of accurate methods in food preparation should furnish many practical suggestions to the interested housekeeper.

Slow processes.

Tough meats should be cooked by some process which will permit long-continued action of moderate heat. The fundamental principle of all the methods used for this purpose is to prevent high temperatures by limiting them to the boiling point of water. Boiling, steaming, braising, pot-roasting, stewing, all illustrate this principle.

Boiling is the origin or foundation of all these methods, the others being only variations to improve or change the flavor. As has already been pointed out, prolonged cooking in boiling water makes meat tough and stringy, and the modern method is to cook in water below the boiling point. The meat is plunged into boiling water and the temperature is then lowered to about 185° Fahr., and kept there for the length of time desired, varying from three to four hours in the case of a stew to six to eight hours, or even longer, in the case of a roast. This long, slow cooking should make the meat very tender, and if properly done with low, steady temperature and time enough allowed, a tough piece of meat should slice through as easily as a tender piece of chicken. It should be coherent, and not fall to pieces.

FIG. 301. A casserole.

Pot-roasting and braising combine the dry- and moist-heat methods. The meat is well seared and browned before being put into a closely covered kettle, casserole (Fig. 301) or pot of some kind. The cooking then continues in the slow way above mentioned, until the connective tissue is thoroughly gelatinized. This combination of browning with

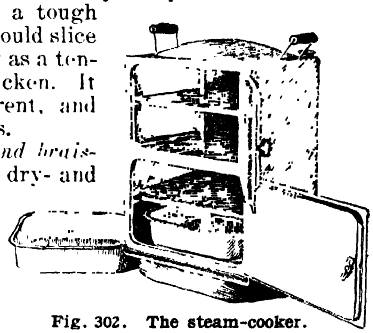

FIG. 302. The steam-cooker.

water-cooking gives a richer flavor, and renders the meat more attractive and palatable than simple water-cooking alone. Almost any cut in the animal may be made tender and palatable by properly conducted, long-process cooking, and a little experience will soon give skill in regulating temperature and time. These long processes of cooking may be consummated very economically in a properly equipped kitchen. The steam-cooker (Fig. 302) for the top of a gas burner or small stove, deserves better recognition than it has. The Aladdin oven (Fig. 303) should be in every household, for it furnishes an accurate, satisfactory and economical means for maintaining steady, low temperatures. The "fireless cooker" is deservedly coming into common use in this country (Fig. 304.) This is simply a device for conserving heat that is previously generated on the top of the stove. The principle of construction is to have a thick nest of some closely packed non-conducting material, such as mineral wool, asbestos, wool, excelsior, sawdust, hay or the like, surrounding the receptacle containing the hot material. The non-conducting, surrounding substance allows but slow dissipation of heat, and a slow, moderate temperature is thus maintained for a long period of time. There are several of these "fireless cookers" on the market, but any ingenious person may construct one, which, if carefully made, will prove very satisfactory. In brief, the "fireless cooker" is a tight box, tightly packed with non-conducting material. A space in the center is allowed just large enough to hold the receptacle to be used, and the surrounding material should be of about equal depth on all sides. A thick cushion of the same material should be made to cover the top and fit tight, and the top of the box should lock closely over all. The utensil used should have a tight-fitting cover. If meat is to be cooked in such a "cooker" it should be completely covered with boiling water and allowed to boil a few minutes before the kettle is covered and put in the cooker. Experience will soon give skill in the use of such an apparatus.

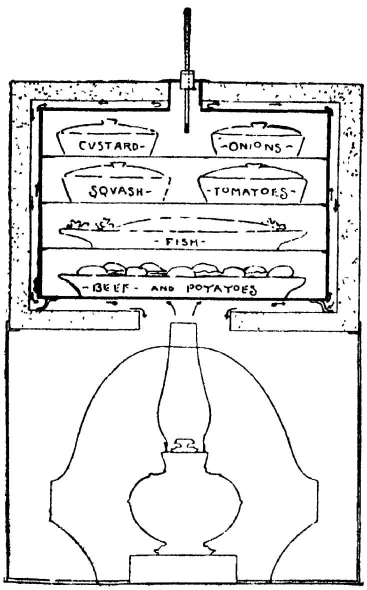

Fig. 303. The Aladdin oven, showing principles of operation.

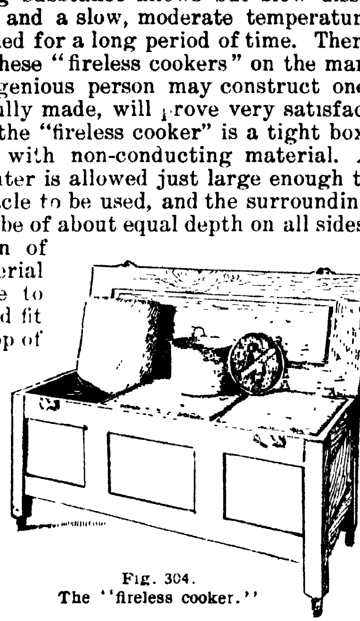
Fig. 304. The "fireless cooker."

Nutritive value of meat.

Meat has a high nutritive value, which in the sense of fuel-value, is due largely to the amount of fat it contains. A comparison of the composition of various kinds of meat, as given in the following tables (adapted from United States Department of Agriculture, Office of Experiment Stations, Bulletin No. 28), will show their variations in nutritive value to be due rather to a difference in fat content than to a difference in the amount of protein they contain :

TABLE IV

Food materials	Water	Protein	Fat	Ash	Fuel-value per pound
Beef—					
Fore-quarter, edible part	62.5	18.3	18.9	.9	1,135
Hind-quarter, edible part	62.2	19.3	18.3	.9	1,130
Sides, edible part	62.2	18.8	18.8	.9	1,145
Veal—					
Fore-quarter, edible part	71.7	20.0	8.0	.9	710
Hind-quarter, edible part	70.9	20.7	8.3	1.0	735
Lamb—					
Fore-quarter, edible part	55.1	18.3	25.8	1.0	1,430
Hind-quarter, edible part	60.9	19.6	19.1	1.0	1,170
Mutton—					
Fore-quarter, edible part	52.9	15.6	30.9	.9	1,595
Hind-quarter, edible part	54.8	16.7	28.1	.8	1,495
Pork—					
Ham, fresh, lean, edible part	60.0	25.0	14.4	1.3	1,075
Loin, tenderloin, edible part	66.5	18.9	13.0	1.0	900
Shoulder, edible part	51.2	13.3	34.2	.8	1,690

TABLE V.—BEEF

Food materials	Water	Protein	Fat	Ash	Fuel-value per pound
Ribs, lean, edible part	67.9	19.6	12.0	1.0	870
Ribs, fat, edible part	48.5	15.0	35.6	.7	1,780
Round, lean, edible part	70.0	21.3	7.9	1.1	730
Round, fat, edible part	60.4	19.5	19.5	1.0	1,185
Fore-quarter, lean, edible part	68.6	18.9	12.2	.8	865
Fore-quarter, fat, edible part	53.5	15.9	30.0	.7	1,560

Increase of fat in a meat product means a decrease in water content and a lesser though marked decrease in protein content, with an increase in food value. As the loss in water and protein is replaced by fat, the economy of purchasing beef well marbled with fat is obvious. This is best illustrated by a table which compares the composition and calorie value of similar cuts of the same kind of meat, having varying amounts of fat.

Influence of cooking on the nutritive value of meat.

A consideration of the nutritive value of soups and broths will be included in this heading, since the amount of nutritive material that meat loses when cooked in water goes directly into the broth.

When meat is cooked, no matter by what method, it undergoes a distinct loss of weight. Considerable work has been done to determine what part of this loss of weight is water and what part consists of the nutrients of the meat. Grindley (Office of Experiment Stations, Bulletin No. 162) reports a number of such experiments made on various kinds and conditions of meat, subjected to different methods and temperatures of cooking.

On an average, meat loses about 45 per cent of its water content by boiling, with a variation from 18 to 67 per cent; 7 per cent of its protein, with a variation from 3 to 13 per cent; 45 per cent of its mineral matter, with a variation from 20 to 67 per cent; 0.6 to 37 per cent of its fat content.

The fatter cuts of meat lose less water, protein, and mineral matter, but more fat than the leaner meats. On an average, the larger the piece of meat the smaller the percentage losses. Close study of the above figures will show the nutritive value of broth to be very small indeed, as even under the most favorable conditions of treatment, meat loses at most but 13 per cent of its total protein; and the average of a large number of broths gives the following composition: Water, 97 per cent; total solids, 3 per cent. Of these total solids, the composition was as follows: Protein, 0.3; extractives, 1.3; fat, 1.3; ash, 0.5. As extractives have only a very small fuel-value, and are of use to the body only as stimulating agents, some of the fallacies concerning the high nutritive value of meat soups are made clear.

The richness of broth increases as the time of cooking increases, and as the size of the pieces of meat making it decreases. If the broth of meat cooked in water is eaten with the meat, there is practically no loss of nutritive material. "Soup" meat will thus be seen to be nearly as rich in nutrients as the joint especially prepared for the table. About 70 per cent of the extractives have been removed, leaving it comparatively tasteless, but, while this loss of the stimulating property of the meat may lessen the ease and rate of digestion, it is a mistaken idea that its nutritive value has been materially affected.

Meat cooked by dry heat loses less than that cooked in water. The average loss by this method of cooking is: Water content, 35 per cent; nitrogenous extractive, 9 per cent; non-nitrogenous extractive, 17 per cent; fat, 7 per cent; ash, 12 per cent. Practically no proteid is lost.

The conclusions to be drawn from the above are, that the chief effects of cooking on meat are changes produced in appearance, texture and flavor, with but little effect on the nutritive value.

Comparative digestibility of meat products.

It is commonly thought that different meats show a considerable difference in the relative ease with which they are digested, and that the method of cooking meat is an important factor in its digestibility. Some experiments reported by H. S. Grindley (United States Department of Agriculture, Office of Experiment Stations, Bulletin No. 193) seem to indicate that these differences are not strikingly great.

Place of meat in the dietary.

Something may be said of the place of meat in the dietary. Meat has a high food value, and it seems to be digested and absorbed with comparative ease and rapidity; but, in spite of this, there is a growing tendency toward the belief that meat furnishes too large a percentage of the protein in the dietary of many persons. There is much controversy with regard to the amount of meat that should be eaten, and how much of it should be replaced by a freer use of milk, eggs, and other foods. The protein of milk and eggs is said to be more easily and completely made into the tissue of the growing child than that of meat. Some of the best known authorities who advocate the free use of meat in the dietary of the adult, think that it should have little or no place in the diet of the child before the sixth year. Its stimulating quality is given as one reason for its elimination from the dietary of the child.

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TANNING HIDES

By *John F. Porter*

It is the purpose of this article to set forth briefly the practical aspects of the tanning of hides. A full discussion of tanning materials is found in Volume II, pages 623-629.

The first thing in the process of tanning is to see that the hides are properly salted. All hides should be salted as soon as they are cooled after they are taken from the animal. [See page 252.]

The beam-house work.

When the hides reach the tannery, they are put into the "soak;" that is, they are put into vats of water to soak out the blood and salt. They are left in these "soaks" for about twenty-four hours, when they are taken out, the head, feet and tail cut off, and are split up the middle of the back, making "sides" of them. The "sides" are run through a machine called the fleshing machine, which removes all the fat and flesh that may be left on. They are then put into the "limes," that is, into vats containing lime-water, which swells them and loosens the hair. They are left in these lime-vats about seven days, or until the hair slips easily. Then they are taken out and the hair scraped off, either by a machine or by hand.

After the hair is taken off, the "sides" are placed in another vat, which contains a paddle-wheel like the wheel of a steam-boat; this is called the "bait" wheel, and the solution in the vat is called the "bait." There are various kinds of bait, but the most common is made of chicken manure, which is boiled, and the liquid put in the vat. This bait kills all the lime in the hides and makes them soft.

The tan-yard work.

The sides are taken from the bait-wheel and are washed. Then they are put into the vats with the tanning liquor, which is rather weak. They are handled every day to keep them an even color and to tan them more evenly. Each day they are put into a stronger liquor until tanned.

The tanning liquor may be of several different tanning materials; hemlock and oak barks are the most common sources. Then there is the chrome process, composed of chemicals and acids. It tans in twenty-four hours. Furs are generally tanned in the pickling tan of salt and alum. There is also the oil tan, which is used for all skins such as buckskins.

After the sides are tanned through, they are put in a press and most of the liquor is pressed out of them. From the press, they are run through a splitting-machine to split them down to the required thickness. Most of the shoe-leather is split to six ounces, which is the accepted thickness for this purpose. The splits that are taken off are finished and put into shoes.

From the splitting-machines, the sides are again milled in the tanning liquor, so that if there are any "green" spots they may be tanned. After they are milled, they are hung up to dry. When thoroughly dry, they are taken down and dampened in water, just enough so that the water will show when the side is doubled and squeezed.

The leather is now ready for the grease. The water is put into the leather so that it can take only a limited quantity of grease. This process is called "stuffing." In stuffing, there are different kinds of grease to be used, depending on the kind of leather that is wanted. Soft leather requires tallow and dagras; hard leather should be stuffed with wax and hard grease.

After the sides are "stuffed" they are put on a table and all the "stretch" is taken out; that is, they are stretched and smoothed out by tools for that purpose. Then they are hung up to dry. When dry, they are taken down and finished in various ways according to the purpose for which they are intended.

If russet leather is wanted, the sides are staked out on a machine called the staking machine, and are then placed on a table and grained by hand. If pebbled black grain is desired, the sides are blackened with logwood vinegar and old iron. They are then oiled. If pebbled grain is wanted, they are run through a pebbling machine to give the desired print. If smooth grain is desired, they are staked out and finished with a dressing of nigersene, glue and soap to give a glossy polish.

Harness- and sole-leathers are not split, but are left as heavy as the hides. Sole-leather is rolled and dried. Harness-leather is stuffed by hand with tallow, and is set out and dried, after which it is blackened and polished.

There is nothing that goes to waste in a tannery. All the pieces of the hides that are trimmed off are made into glue. The tails are dried and sold to mattress factories to be made into mattresses. The hair is washed and dried and sold for plastering purposes. All such apparently waste parts as fleshings and manure are saved and made into fertilizing material.

THE LEATHER AND HIDE INDUSTRY

The leather and hide industry has reached enormous proportions. Beginning with the uses of hides for clothing among primitive peoples, the demand has gradually increased until the capital invested in the commercial industry is in the hundreds of millions of dollars. During this period, new classes of animals have attracted attention for their pelts, new methods have been devised for preserving and tanning hides, and very great numbers of tanning materials have been discovered. [See Vol. II, pp. 623–629.] A writer in the New International Encyclopedia (Vol. XI, p. 87) speaks as follows regarding the early development of the tanning industry: "Probably the original process of curing skins was that of simply cleaning and drying. Then the use of smoke, sour milk, various oils, and the brains of animals themselves were found to improve the texture of the leather. Later it was discovered that certain astringent barks and vegetables effected permanent changes in the texture of skins, and stopped decay. This knowledge was possessed by the ancient Egyptians, for engravings on their tombs depict the process of tanning. In China, specimens of leather have been discovered in company with other relics that prove them to be over three thousand years old. The Romans used leather which they tanned with oil, alum and bark."

The tanning, tawing, currying and finishing processes of the present day are the slow growth of centuries, and the production of leathers of the modern quality and variety is the culmination of years of study by practical tanners and by chemists.

Bulletin No. 72, Census of Manufactures, 1905, on "Boots and Shoes, Leather, and Leather Gloves and Mittens," issued by the Department of Commerce and Labor, of the Bureau of the Census (1907), is a very valuable contribution on this subject. The notes and tables that follow have been gleaned from that report. In regard to the classification of hides, and the influences that affect their quality, this bulletin speaks as follows:

"The skins of larger animals, such as oxen, cows, horses, etc., are called hides to distinguish them from the skins of smaller animals, such as calves, goats, sheep, deer, hogs, seals, etc. Kip is the term applied to the skins of small beef or cattle. The quality and substance of the skin are affected by age, skins from younger animals being the finest in grain and taking dye better; by sex, leather made from the female being finer in texture than that made from the male; by breed, as the higher the breed the less thick the skin; by the care given the animal, animals raised in the open air having a coarser skin than those raised indoors; by state of health and food eaten; by the gadflies, known as wormils, warbles, or grubs, which deposit their eggs on or in the skin, producing sores; by contact with barbed wire, which scratches the skin; by ticks and scabs, which infect sheepskins; and by the mode of preventing putrefaction of the skin after the animal has been slaughtered."

Extent of the industry.

For the year ended December 31, 1904:

Number of establishments	1,049
Capital	$242,584,254
Salaried officials, clerks, etc., number	3,251
Salaries	$4,451,906
Wage-earners, average number	57,239
Total wages	$27,049,152
Miscellaneous expenses	$12,498,501
Cost of materials used	$191,179,073
Value of products, including custom work	$252,620,986

Distribution of the capital invested:

Land	$9,842,911
Buildings	35,684,642
Machinery, tools and implements	32,889,457
Cash and sundries	164,167,244

Materials used in 1905:

	Number of Establishments	Quantity Number	Cost
Hides, all kinds	669	17,581,613	$89,126,593
Calf and kip skins	192	12,481,221	15,725,616
Coltskins	19	1,336,848	2,007,160
Sheepskins	204	27,492,359	10,547,883
Goatskins	119	47,665,603	26,756,012
All other skins	64	1,649,033	1,304,661

The rank of the first five states in capital invested in the leather industry in 1905, was:

Pennsylvania	$72,972,114
Wisconsin	30,409,164
Massachusetts	27,070,206
New York	24,037,904
New Jersey	12,492,373

The rank of the first five states in value of products for the same year, was:

Pennsylvania	$69,427,852
Massachusetts	33,352,999
Wisconsin	25,845,123
New York	21,642,945
New Jersey	21,495,329

The following table gives the value of leather products, according to geographical divisions, in 1905:

North Atlantic division	$151,629,879
South Atlantic division	29,108,634
North Central[1] division	54,768,282
South[2] Central division	8,441,776
Western[3] division	8,614,991

[1] Exclusive of Iowa, North Dakota and South Dakota. [2] Exclusive of La. and Miss. [3] Exclusive of Colo. and Utah.

Value of the exports of the principal kinds of leather for the year ended June 30, 1905:

Total	$28,058,342
Sole	9,444,873
Kid (glazed)	1,576,204
Patent or enameled	166,320
Splits, buff, grain and all other upper	15,057,791
All other leather	1,813,154

The value of imports of the principal kinds of leather for the year ended June, 1905, follows:

Total	$5,612,642
Band or belting and sole leather	92,079
Calfskins	605,960
Skins for morocco	2,446,481
Upper leather, dressed, and skins, dressed and finished, not elsewhere specified	2,468,122

PART III

NORTH AMERICAN FARM ANIMALS

Having taken a rapid view of many of the primary considerations involved in the rearing and utilizing of good animals, we now proceed to a definite discussion of the different kinds. The species of domestic animals are few, as compared with domestic plants, and an alphabetic arrangement is not so necessary; yet, if any arrangement is attempted, this is as good as any. In this volume, as in the other three, however, the reader must rely largely on the index for ready reference, for it is impossible to give a general encyclopedia of agriculture an alphabetic order. It is the aim of this volume to give the reader a comprehensive knowledge of the animals that are commonly included in the term live-stock; yet the book would not be at all complete if it did not also discuss the other animals that are or may be profitably reared to supply food and clothing, as bees, fish, oysters, and fur-bearing animals. It has seemed best to include brief sketches of dogs and cats in the way that they are conceived to be farm animals, although a detailed discussion of pets or of mere fancy animals is not in place in a work of this kind.

Fig. 305. The head of the flock.

Zoötechny.

The knowledge, practice and industries concerned in the rearing of animals have recently been designated by the word zoötechny (Greek words for *animal* and *handicraft*). The correlative term for the crop industries is agronomy, although in the agricultural colleges this word has come, inappropriately, to be used for only those crops that are at present comprehended in the word horticulture. A technical correlative is phytotechny; but probably neither zoötechnyn or phytotechny will ever become really common-language words.

The two great phases of live-stock agriculture are the rearing of the animals and the manufacture of their products. There are husbandries and technological industries. In the agricultural colleges, these phases are beginning to be separated into different chairs or departments, but there is not yet any clear terminology to distinguish them. The rearing of live-stock, of all kinds, is properly animal husbandry; divisions of it are: poultry husbandry, sheep husbandry, swine husbandry, beef husbandry. The technology is a manufacture or industry, as dairy industry, meat industry. This Volume III is practically a brief treatise on animal husbandry and technology.

Animal husbandry advice.

The Editor has endeavored to emphasize the agricultural utility of the animals, rather than to make a book of mere formal aud historical description of breeds. This is difficult to accomplish as yet, for the literature of live-stock is mostly conceived on another basis, and the real farm efficiency of the animal has received relatively little attention. It has been the tendency for live-stock writers to be advocates, and to uphold the particular breed. We are now coming to a non-partisan treatment of animals, as a result of scientific and therefore impartial study, by the college men, of the really vital questions

involved in the animal husbandries. In the next fifty years the literature of the subject will no doubt be entirely re-written on a new basis.

Literature.

The special literature on the different animals and breeds is mentioned in connection with the various articles. Of course the reader will consult the herdbooks of the different breeds if he is seeking pedigree and history. He must also keep in touch with the literature of the experiment stations, the agricultural press and the national Department of Agriculture. There are few American books covering the general live-stock field, aside from diseases, breeding and feeding, as Plumb, "Types and Breeds of Farm Animals;" G. W. Curtis, "Horses, Cattle, Sheep and Swine;" J. A. Craig, "Judging Live-Stock;" Shaw, "The Study of Breeds;" Sanders, "Breeds of Live-Stock."

NEEDS IN ANIMAL HUSBANDRY

By JAMES WILSON

The domestic animals of our country present one of the most interesting assets of our national prosperity. Animals change greatly from generation to generation, the change being coincident with the general modification and progress of civilization, and with the necessities of the people at any given time. It is well to recall how crude the beginnings were, and yet to realize how much we need to improve our present animals.

The early importations of Spanish horses and cattle were well enough suited to conditions at that time, but they would be of little value in our day. Hardiness in a horse and powers of endurance in a cow in times of stress were required when feed was scarce and uncertain, and shelter primitive; while responses in service from the horse, and yield in meat, work, or dairy products from the cow and her kind for every dollar invested and for every pound fed, are the imperative requirements of our modern times. The saddle, light vehicle, pad or yoke were useful in colonial days, when surplus farm crops were exchanged in Europe for the products of the shop and factory. But, after manufacturing had made progress in the United States, and a class of people multiplied that grew no crops and bought its food, new demands came to the American farmer that could not be profitably supplied from the early importations.

It was learned that nature, by means of pastures, restored fertility to a soil that had been long under cultivated crops, that harmful insects disappeared when the land was grazed, that droughts had less effect on crops following the pasture, and that heavy yields of all crops came from the plowed-up sward; and consequently rotation developed. How nature and the pasture agreed about these, authorities differed in those days, and they differ yet; practical farmers saw the results then, and they see them now, and they rotate their crops, whether understanding all the reasons or not.

But a new difficulty presented itself: the saddle horse or light draft horse might plow up a stubble field, but he was not heavy enough or strong enough to plow up an old pasture. A heavier, slower, quieter horse was wanted. The British Isles and the continent of Europe were called on, and the heavy draft breeds were imported to meet the emergency. As more pastures are to be plowed up with the development of the country, importations continue. Heavy draying in our cities requires heavy horses; work in the forests demands weight in the collar; and higher-priced labor on the farm is, to a considerable extent, met by heavier horses and modern farm machinery.

We import the Shire horse and the Clydesdale, the French draft horse and the Belgian, with grades and crosses of these breeds that more or less impress themselves on what may be called our native horses. We import these breeds to all the states, to all our conditions of soil, climate and pasture. We have not had time to develop horses suitable to all localities, nor, in fact, to any special locality. The various problems embraced in horse-breeding are under consideration by the federal government, by some of the states, and by many individuals, and no doubt the future will do something toward producing special breeds for the several uses to which horses are adapted. The federal government is at work in Colorado, in coöperation with the experiment station of that state, for the purpose of establishing a heavy carriage horse by selection from the American trotting horse; and it is at work in Vermont, in coöperation with the experiment station of that state, for the purpose of reëstablishing the Morgan horse. The trotting horse is an American production, and one of the few successes we have had in breed-

ing for a purpose. Our mountain states are peculiarly adapted to the development of horses with good bone, lung development and high courage. Horse-breeders of the states of high altitude have not been careful with regard to early development through good feeding for size sufficient for many desirable uses, such as the army horse, the saddle horse, the heavy carriage and hunting horse. It is hoped that the Colorado experiment will contribute to our knowledge of breeding and feeding for these purposes. The Vermont Morgan horse was a common-purpose animal, well adapted to most uses that did not require heavy weight. The New England farmer used oxen for heavy draft work, and found the Morgan horse excellent for light farm work, road work, saddle work, the stage and the hack. He has been crossed with our best strains of track horses, and impressed his strong individuality on all of them. The best Morgan blood is being assembled at the Vermont station with hopes of good results.

Horses are grown more economically on the farm in connection with farm operations than elsewhere. Three brood-mares will do as much work as two geldings. Colts of the draft breeds earn part of the cost of raising while being taught to work. From one to three years of age, a good pasture does most of the feeding, summer and winter, when snow does not cover the grass deeply, and healthier animals are grown out-of-doors than in stables. The grass should be abundant or be supplemented by grain.

Dairy products were early in request, and the dairy breeds of the British Isles and the continent of Europe were imported. They required better pastures, and cultivated grasses were sought in many lands suitable to varying conditions of soil and climate, and the necessity is still with us to search the world for desirable grasses and legumes. New demands are constantly arising in the dairy sections of the great North American continent. The beef industry must readapt itself, with the great change in our agricultural and economic conditions. Yet, with the exception of the relatively unimportant French-Canadian cattle, we have not yet developed any American breed of dairy or beef cattle.

Spain gave us the most valuable fine-wool sheep the world could contribute at that time, and they have been the foundation of unequaled flocks of that class, peculiarly adapted to the necessities of many localities where large flocks are herded together under conditions that are independent of cultivation and its accompaniments. When our growing cities called for mutton, the Merino sheep failed to give as good satisfaction as it did as a producer of fine wool. Importations were made from Great Britain of her mutton sheep that gave the best mutton, with wools desirable for clothing. These breeds are not suitable for herding in large flocks, but are profitable on our high-priced farm lands, and are rapidly extending over our most densely peopled farming districts. The lambs mature early and are in pressing demand at profitable prices. Few domestic animals are more profitable than the mutton sheep, and farmers who do not have help to milk cows find them a very desirable department of the farm. The dairy cow, where dairying is understood and where help can be had to milk her, is perhaps the most profitable farm animal; but dairying is not well understood everywhere and help cannot always be had to milk twice a day seven days in the week; the sheep requires as high intelligence to manage as the cow, but there is less labor and shorter days required to do it. Dogs are the traditional enemy of the sheep, but the woven wire fence is ample protection; and altogether we look to see the sheep get more attention in the future.

The farmer reached the Mississippi valley before the railways; he grew corn before there was an outlet to market, for it; he bred hogs to turn corn into meat and lard. There are several breeds that answer this purpose. It was supposed that the advent of coal-oil would injure the hog industry, but the demand for hogs has continued to grow, and prices to be profitable. The western farmer learned to use the clover pasture to the fullest extent in growing this animal. We cannot improve our hogs by importation. Our hogs are the product of corn and clover. They are distinctly an American production, even when keeping foreign-breed names, and very different from any European hog where corn is not as abundant as it is with us. We have produced one recognized American breed, the Poland-China.

Our poultry yields half a billion dollars a year, not because of any special skill in breeding or feeding, but because we have the world's cheapest grains and grasses. There is scientific coöperation at present between the federal government and the Maine Experiment Station in the hope of developing a strain of hens that will lay 200 eggs a year, with good hope of success; and other stations and individuals are working toward similar ends.

In our crops, we have long ago developed good native varieties, many of them well adapted to our varied localities and conditions. We are only emerging from the importing stage with our animals, however. We need distinctly American and local or special types of farm animals. The conditions and needs will always be changing, and the live-stock will have to change also in its characteristics as time goes on. It is therefore not only a question of producing types of animals for present demands, but to see to it that future demands are met.

ASS. *Equus* spp. *Equidæ.* Figs. 306, 307.

By *C. S. Plumb.*

The ass is a beast of burden. The males or jacks are used much also in the production of mules. (See *Mule.*) The ass belongs to the genus Equus, which includes the horse and allied forms.

Description.

The ass differs from the horse chiefly as follows: The ears are large and long; the mane is short and does not fall to one side; the tail is nearly devoid of long hair, excepting at the extremity; the hoofs are small; chestnuts are lacking on the hind-legs; the period of gestation is about twelve months, instead of eleven, as with the horse. White markings, such as a star in the forehead or white feet, are very rare.

History.

The ass was used as a beast of burden for many centuries prior to the Christian era. Figures of the ass are found in the early Egyptian sculptures, and the animal is frequently referred to in the books of the Bible. Undoubtedly the wild form easily passed into a state of domestication.

In America.—The history of the ass in America dates back into colonial times. About 1787, two jacks, known as Royal Gift and Knight of Malta, were presented to George Washington and placed on his estate at Mt. Vernon. The former, with a jennet, was from the King of Spain, while the Knight of Malta was from Marquis de LaFayette, and came from France. These jacks were used in mule-breeding on Washington's estate and on Virginia mares, and those sired by the French jack were very valuable. The development of the mule industry in Kentucky began about 1800, and many valuable breeding jacks have since then been imported from Spain, Henry Clay being one of the earliest importers. Tennessee, a noted mule-producing state, received its first importation of jacks about 1840. At the present time, Missouri, Kentucky, and Tennessee are leading states engaged in the mule trade, and there important studs of the ass are to be found. Breeders in these states are making frequent importations from Spain and much attention is being directed to the industry.

In 1900, there were in the United States 94,165 asses on farms and 15,847 not on farms. There were on farms in Hawaii 1,438, and in Porto Rico (1899) 1,085. (Yearbook, United States Department of Agriculture, 1906.)

Breeds and distribution.

The wild ass, of two or more species or varieties, is found at present in various parts of Africa and Asia.

The wild African ass (Equus asinus, Linn.) is found in northern Africa between the Nile and the Red sea, and in Nubia and Abyssinia. For various reasons it has been assumed that the domestic ass is descended from the African. The color and markings are very like those of the common ass. The ears are large and similar to those of the domestic form. The common cry of this species is a bray, very like that of the domesticated one. Darwin also notes that the African ass much dislikes to wade a stream of water, a notable trait of the common ass.

The wild Asiatic ass (Equus hermionus, Pallas) is found most commonly over a wide territory in Asia, but especially on the great plains in Afghanistan, Tibet, the Punjab and Persia. While existing usually in small herds, travelers occasionally report seeing them in large numbers. This species has large ears, and the color usually ranges from reddish gray to a fawn or light chestnut. A dark-brown stripe, of variable width, sometimes with a

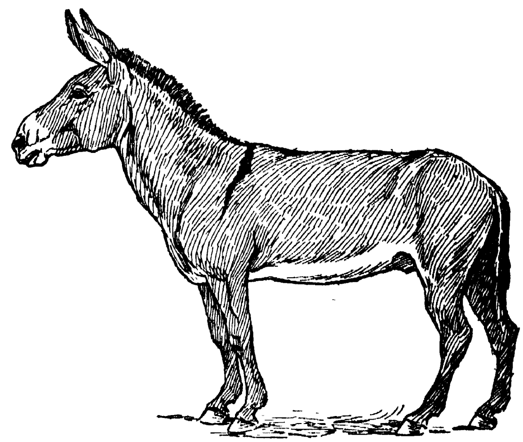


Fig. 306. Wild ass (*Equus asinus*)

white margin, extends from the withers to the tail. The belly is of a whitish color. The height varies from three feet eight inches to four feet.

There are two sub-species or varieties of the Asiatic ass. These are the *Onager*, found in British India, in the Punjab; and the *Kiang*, native to Tibet. The Onager has been credited with great speed and wildness, though this has apparently been exaggerated. The Kiang is native to the high uplands of Tibet, existing at 16,000 or more feet elevation, where the winters are very severe.

The domestic ass is commonly known as the donkey, although the word donkey is often restricted to the small ass or burro. The males are termed jacks or jackasses, and the females are known as jennets. There are a number of breeds, and specimens of them range in size from the diminutive burro, often thirty-six inches high, to the size of a horse of considerable height and weight. Besides the characteristics already referred to, the common ass has a thick, long coat of hair, especially in the cooler months. The character of the hair is very marked with some breeds. The standard color in America is black or dark brown, with a light creamy or mealy shade about the muzzle and along the belly. Gray is occasionally seen, but does not meet with favor, and is not approved by the American Breeders' Association of Jacks and Jennets, the standard organization for promoting this stock in the United States.

The body of the ass is short, the belly rather round, the quarters lack thickness compared with the draft horse, and the legs are strong and impress one as heavy of bone. The power of endurance is a noted characteristic of this animal, while in temperament this is one of the most submissive of beasts. While responsive to good care and feed, no animals of the horse family subsist and maintain strength on such inferior food.

Scattered over the different parts of the world, subject to differences of environment, food, temperature, moisture, and the like, different breeds or varieties of the ass, in the course of time, have gradually taken on specific characteristics. Among the important breeds, especially in application to America and Europe, are the following:

(1) *The Catalonian* is a Spanish breed, especially developed in Catalonia, in the northeastern part of Spain, adjacent to France. It is usually black or brown, the former prevailing, and is marked with light points about the muzzle, eyes, and belly. The hair is naturally thick and short. Good specimens stand fourteen and one-half to fifteen hands high, and occasionally sixteen. In comparison with other specimens of the ass, the Catalonian is an aristocrat, with beauty, style, and action. The head is trim and neat, and the ears well carried. The bone, while not especially large, is very hard and fine of texture and free from fleshiness. It is a very tough, hardy breed, and has found more favor in America, in mule-producing districts, such as Missouri, Tennessee, and Kentucky, than any other breed. Mules sired by these jacks have much size and quality, and have been ranked as the best in the world. A large percentage of the jacks imported to America come from Catalonia. Matured males of this breed stand about fifteen hands high.

(2) *The Andalusian* is native to Andalusia, in southern Spain. It is regarded as a very old breed. The prevailing color is gray, with black somewhat uncommon. The color is objectionable in America, and the breed has not found much favor here, although a great favorite in southern Spain. This is one of the larger breeds, and stands fourteen and one-half to fifteen and one-half hands high. The bone of the leg is large and of superior quality.

(3) *The Majorca ass* is native to Majorca, one of the Balearic islands, in the Mediterranean sea, off the coast of Spain. This breed is of the larger type, drafty in character, standing about fifteen and one-half hands high, or a trifle more. The head and ears are rated as rather large and heavy, and the Majorca has hardly the style and action of the Catalonian. It is usually black or brown. In recent years it is meeting with some favor in the United States, although it has not been extensively tried here. In Spain the breed has long been bred with much purity on its native isle, and large numbers are used in the government artillery service of Spain and other countries. Many jacks of this breed have also been exported to South America.

(4) *The Poitou ass* has been produced for centuries in the province of Poitou, in southern France, bordering on the bay of Biscay. This is a very popular breed in France. It is very drafty and strong of character, although far from beautiful. The head is rather large, the ears long, the chest broad, the body deep and heavy, the quarters spare yet muscular, the legs short but very powerful, with large bones and feet. The height varies from thirteen and one-half to fifteen hands. Black with white points is the prevailing color, although grays occur occasionally, but are ineligible to registry in the French Jack Studbook. A striking feature of this breed is its extremely thick, long coat of hair. This is rarely groomed among French breeders, and usually becomes filthy with manure, and thus very unsightly. The farmers of Poitou breed a drafty, large, powerful class of horses, the mares of which are bred to the jacks of the country, from which result mules of great size and power, and which bring a comparatively high price. Thus far, not many jacks of this breed have been brought to America, and little is known of their adaptability to American conditions.

(5) *The Maltese ass* is native to the island of Malta, in the Mediterranean sea. This is of the smaller type, rarely exceeding fourteen and one-half hands high, and is usually black or brown in color. The breed is of excellent form, with well-carried ears, and is characterised by much life and

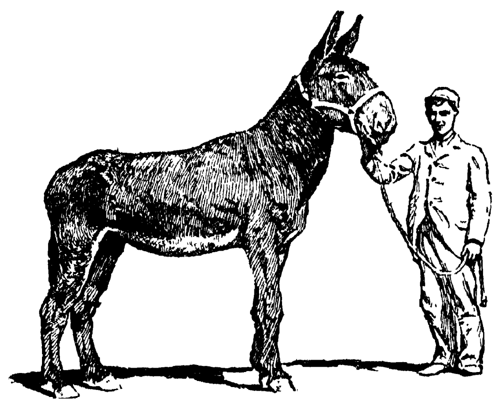


Fig. 307. A prize-winning ass. Antar, Jr., 217.

vigor. The criticism of too much refinement and fineness of bone, and lack of substance, has interfered with the introduction of this breed to America.

Uses.

As a beast of burden.—One purpose for which the ass has a special value is as a pack-animal and beast of burden. Historically, the ass has always served as a carrier of burdens in the hilly semi-tropical regions of the world. As a pack-animal, a small type of the ass, known as the burro, is a familiar sight to travelers in southern Europe, in Ireland, in coal-mining regions in the eastern part of the United States, in northern Africa, Asia, South America, and elsewhere. This animal is extremely docile, will bear a burden with much endurance and stability, and is extremely sure-footed in going over mountain passes and slopes difficult for horses. In

coal-mining regions, either the burro or a small mule is used extensively to haul cars of coal through the galleries of the mines to the unloading hoists.

For mule-breeding.—Superior, well-bred jacks are used in stud-service on mare horses to produce mules —a type of draft animal very highly valued in the warmer sections of civilized countries. Jacks of sufficient merit for such breeding service command very high prices, and various cases are on record in which $1,500 to $5,000 has been paid for them. The trend of values seems to be on the increase rather than otherwise.

Organizations and records.

The American Breeders' Association of Jacks and Jennets is the official organization interested in the development of the ass. It was organized as a stock-company in 1888, at Springfield, Ill. Six volumes of studbooks have been issued to 1907. The Association headquarters are at Columbia, Tenn. Another association for registering jacks and jennets exists in France.

Literature.

Plumb, Types and Breeds of Farm Animals; Riley, The Mule; Tegetmeier and Sutherland, Horses, Asses, Zebras, Mules, and Mule-breeding.

BEES. *Apis mellifica*, Linn. *Apidæ*. Figs. 308–323.

By *W. K. Morrison.*

It is abundantly evident from the records of the remote past that bee-keeping has always been a favorite occupation with civilized nations. Egypt, Babylon, Assyria, Palestine, Greece, Rome, and Carthage all had their bee-keepers, and probably bee-culture in Egypt today differs but slightly from what existed there four thousand years ago. If there is any difference, it is likely for the worse. In the days of Aristotle there are said to have existed two or three hundred treatises on bees, so that then, as now, bee-keeping was a favorite topic with authors. More books have appeared on bees and bee-culture than have ever been published about any domestic animal, not excepting the horse or the dog. Aristotle wrote a special treatise on bees, but all traces of it have been lost, and we are chiefly dependent on Columella for a knowledge of ancient apiculture; and we learn from him that the Greeks were skilful and painstaking bee-keepers. The fourth book of Vergil's Georgics is wholly devoted to bees. It was not until the appearance of L. L. Langstroth's hive (1852) that we of the West may be said to have surpassed the Greeks. In the palmy days of Egypt, when she was at her zenith, floating apiaries were a feature of her apiculture; floating apiaries still exist on the Nile, lacking a historian to record them, for it is admitted by our best bee-keepers that such an apiary requires expert skill to manage it, and American attempts of the kind have ended in failure.

Like other industries, bee-keeping began to articulate in the sixteenth century. Various authors in English, French and German are entitled to credit for their efforts to create a science of bee-keeping free from charlatanism; but it was not till the appearance of the work of Jan Swammerdam, a Dutch naturalist, that bee-keeping may be said to have found its place among the sciences. He illustrated the anatomy of the bee in a masterly way, and set at rest a lot of superstitious notions about bees and their life-history. Had he continued as he began, Swammerdam would surely have anticipated some of the most important discoveries of our time by several centuries. An English edition of Swammerdam appeared about 1757.

The next observer of note was Maraldi, an Italian astronomer, followed by Reaumur, the distinguished French investigator. Reaumur shed a flood of new light on the habits of bees at work in the hive; but as he neglected to state by what means he had obtained his information, readers were slow to believe him. Huber, a blind Swiss naturalist, took up the work of Reaumur where he left off, and with the aid of his faithful, clever wife, and an extraordinarily able hired man named Burnens, proved Reaumur's work on the habits of the honey-bee to be correct, in the main. His work is a masterpiece in experimentation; and all entomologists, as well as bee-keepers, are generally indebted to him. Henceforth, empirical bee-keeping was at a discount. Huber invented a leaf-hive to enable him better to conduct his researches, so that he was the original inventor of movable combs, the basis of practical bee-keeping in the United States and Europe. But Huber's hive was not practical. It was not until the Rev. Lorenzo Lorraine Langstroth, of Philadelphia, invented his movable-frame hive, in 1852, that bee-keeping developed into something more than a pleasant and profitable fad.

It is difficult to convey to the lay mind the importance of the Langstroth invention, but it is comparable to the invention of the locomotive in land transport. The whole science of bee-keeping has been recast, and Langstroth's hive has been adopted in some form by the United States, Canada, Mexico, West Indies, South America, South Africa, Australasia, England, France, Switzerland, Belgium, Russia, Scotland, Ireland, Wales, and other less-known countries. Germany, Austria, Poland, and other central European countries, under the advice of Dzierzon, have refused to adopt Langstroth's invention; but there can be little doubt as to its ultimate conquest of these countries also. Pastor Dzierzon, who was born in 1811, three weeks after the birth of Langstroth, who died in 1906, at his home in Silesia, Prussia, had by virtue of his ability exercised immense autocratic influence on European apiculture, due to his discovery of the law of parthenogenesis as applied to bees. Dzierzon had noted that when a pure Italian queen was mated with a German drone, the females were cross-breeds, while the drones were pure Italians; hence, he asserted that the drones had no father. Prof. Von Siebold, the brilliant German microscopical anatomist, at once saw the importance of Dzierzon's discovery, and hastened to his assistance and, with characteristic German thoroughness and consummate skill in

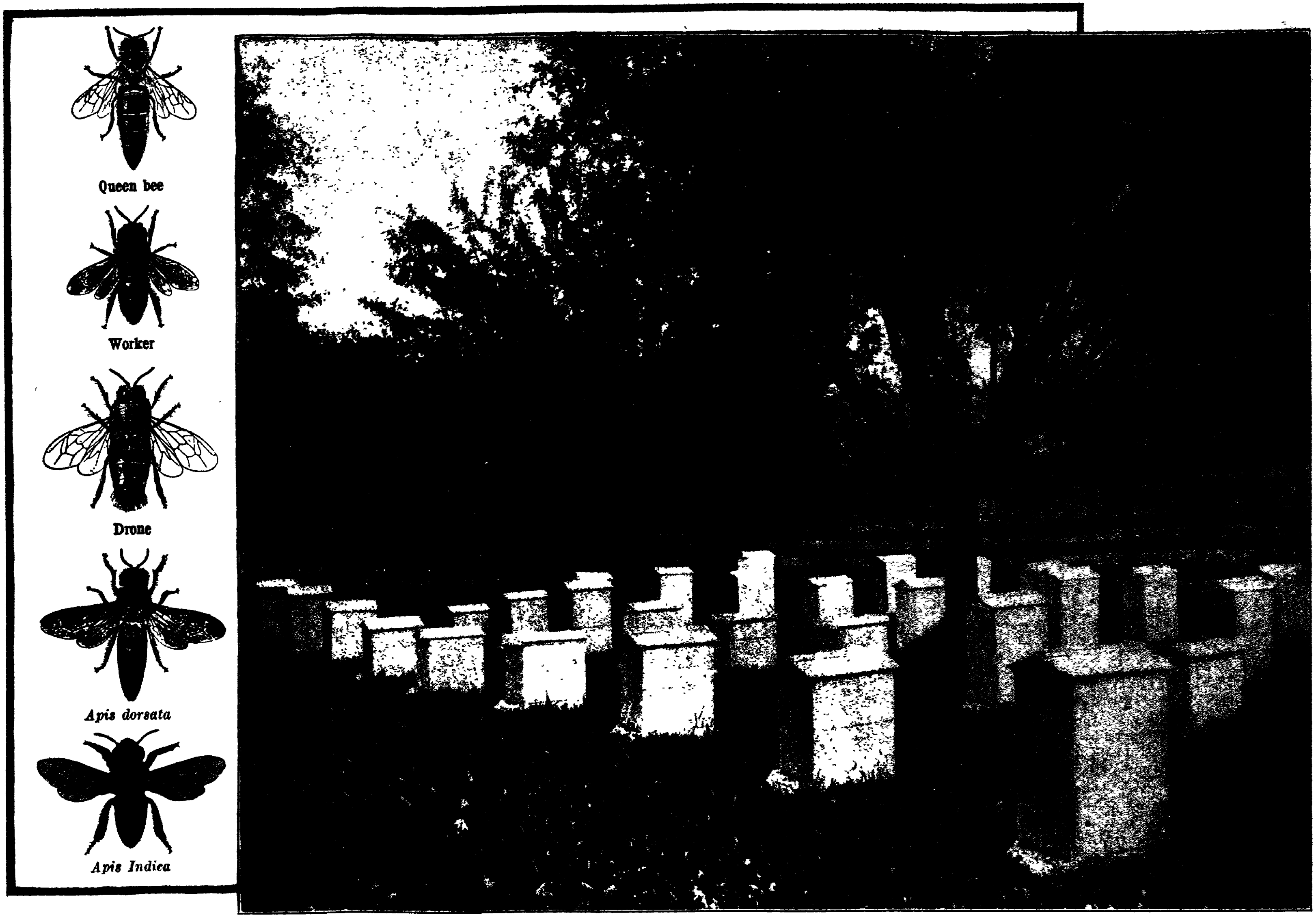


Plate VI. A good farm apiary; different forms of the honey-bee; *Apis dorsata* and *A. Indica*

handling microscopical materials, he labored until the law was firmly established. Of course, a knowledge of the workings of the law of parthenogenesis is necessary to all bee-breeders with any pretensions to scientific skill.

Dr. Von Planta, a Swiss *savant*, now dead, also put us under abiding obligations to the land of Huber by his brilliant researches into the chemistry of the bee-hive. In scientific, painstaking style he furnished us with an analysis of the flower-nectar, honey, honey-dew, royal jelly, chyle food, bee-bread, wax, and the like. We, of America, are much in want of a clear exposition of Von Planta's work in the English language.

It only remains for us to mention the work of A. I. Root in the United States. The friend of Langstroth, he set about the work of improving our hives and other necessary appliances, and with the true Yankee sense, succeeded in making American apiarian implements the standard of the world; and the present proud position of our apiculture as the model for all others, is in no small part due to the work of Root, who took up the work of improving crude and imperfect apicultural tools until America was recognized as the land of bee-keepers, bee-ranches, bee-appliances, honey, and wax.

At the present time, our apiculturists are optimistic, self-reliant, and as inventive as ever before, and the future is full of promise. In Europe, bee-keeping is often stated to be an ideal occupation for peasants. With us, the highest intelligence is required, and our bee-keepers turn out tons of honey, whereas they of the old nations produce hundredweights. On reliable authority, California is stated to have produced for export, in one year, five hundred carloads of fine honey, single apiarists producing as much as eighty tons; and one baking concern has bought approximately one thousand tons in one lot. Apiarists who can produce twenty to thirty tons of honey per annum are not unusual. Europeans are loath to believe of our success, but both England and France have frankly admitted our superiority by adopting our methods. The quality of our honey is also higher than European, in general, due to the far greater mobility of our hives, enabling us to keep the honey of each flower separate from any other with the greatest ease.

The honey and wax industry of the United States has an annual value of between $20,000,000 and $30,000,000, and this on a capitalization of about $100,000,000. There is much room for improvement, as far better results could be secured without increasing the capitalization. On $100,000,000 of capital we should secure at least $50,000,000 of return. In many parts of this country, bees are still kept in common boxes and hollow logs, particularly in the Southern states, where the conditions are good for successful bee-keeping.

Classification of bees.

Among insects the bee is placed by entomologists in the order Hymenoptera, with ants and other insects having four membraneous wings. It belongs to the family Apidæ, or long-tongued bees; to the genus *Apis* and the species *mellifica*. Linnæus originally named the ordinary hive-bee *Apis mellifera*, meaning honey-gatherer. On having the fact pointed out that the bee makes honey from flower-nectar, he changed the specific name to *mellifica*, meaning honey-maker. Attempts have recently been made to change this latter name in accordance with the law of priority in scientific names, but the name *mellifica* is so well-chosen, and so firmly-established in bee literature, that it would be a sacrilege to change it.

A careful systematic study of the different species and subspecies or varieties of the genus Apis found in all parts of the world was published in 1906 by H. von Bettel-Reepen. The following arrangement is adapted from his work (varieties of *Apis dorsata* and *A. Indica* omitted):

- *Apis dorsata*, India and eastward.
- *Apis florea*, India, Ceylon, Java.
- *Apis mellifica*, the common hive-bee in many subspecies and varieties:
  - (*a*) Subspecies *mellifica* proper, with varieties *Ligustica, remipes, Carnica, Cypria, Lehzeni.*
  - (*b*) Subspecies *Indica*, with varieties *Peroni, Sinensis, Japonica, picea, Koschevnikovi.*
  - (*c*) Subspecies *unicolor*, with varieties *Adansoni, fasciata, intermissa, Friesei, Syriaca.*

Two species have not been domesticated, — *dorsata*, the giant of the genus, and *florea*, the dwarf. Attempts have been made to reduce *dorsata* to a state of domestication, but its nomadic habits, fierce temper, and custom of living out-of-doors render the task difficult. To introduce *fasciata, Adansonii, unicolor* and *Indica* into the United States would seem to be entirely feasible; and such a bee as the Egyptian — beautiful and industrious — should find a place in America, very probably in Arizona and California.

We know but little about the bees of China and Japan, except that the natives of those countries have had them domesticated for centuries. We know, also, that the Chinese bees are smaller, hence, American hives and apparatus are failures with them. The same is true of the *Apis Indica*, a very useful bee.

The stingless bees of South America, *Melipona trigona* and *M. tetrasoma*, have recently occupied some attention with apicultural students. Von Ihering, of Brazil, and Morrison, of the United States, have devoted considerable attention to them, with the result that we are able to get a fair conception of their value.

It is evident that in South America we have to do with an immense number of bee species, some of which are readily domesticated and have been kept in apiaries for centuries by the natives. It seems probable that the natives, so ruthlessly swept away by the Spaniards under Pizarro, were good bee-keepers. Captain Basil Hall, in the eighteenth century, mentions stingless-bee apiaries in Peru. Koster also mentions them in Brazil. In so large a country as the United States a place prob-

ably will be found for them. Honey-gathering wasps are also common in tropical South America.

There are a number of sub-species or races of bees cultivated in this country at the present time, all having their partisans:

Apis mellifica:
- Blacks, or German race.
- Italian.
- Albino (a variety of the Italian).
- Cyprian.
- Holy Land, or Syrian.
- Carniolan.
- Banat.
- Caucasian.
- Hybrids, cross between Italian and German.
- Punic.

In general popularity, the Italians easily lead, and justly so. The Cyprians and Holy Lands have had a fair trial and, all things considered, are not equal to the Italians. The Carniolans are favored for elevated cool localities in the North. The only American breed is the Albino, a beautiful sport from American-bred Italians.

The Italian bee has been so carefully nurtured in this country that our bee-keepers now send queens of this breed to all parts of the world, in small mailing-cages. They have sent them repeatedly to Italy to improve the race there. There is some danger at the present moment of the production of an American mongrel as a result of the indiscriminate introduction of new races. We control the fertilization of queens so badly that it is with great difficulty we can keep our bees pure. Only bees of very considerable distinctive qualities should be experimented with, or the result is chaos; and this stage has already been reached in some places.

The queen.

Cattle-breeders say the bull is half the flock; with equal truth bee-keepers can affirm that the queen is 75 per cent of a nest of bees, for the law of parthenogenesis operates to give greater importance to the queen. The least imperfection in a queen is fatal, and some bee-keepers fail at this very point. It is frequently noted that a colony of bees will give a handsome return, while a colony at its side under precisely similar condition will give no return at all. This is simply due to the difference in the queens; hence, successful bee-keeping depends largely on paying the greatest possible attention to the queens of the apiary.

The queen is the only fully developed female in a hive of bees; that is to say, she has not had to submit to a process of weaning on the fifth day of her existence (from the laying of the egg) as is the case with workers. On the contrary, she is fed in the most liberal manner on royal jelly, a predigested food made by the nurse-bees for the occasion. The workers, on the other hand, never seem to get enough food—chyle-food, a sort of bee milk —and before being closed up to undergo their transformations, are fed a meal of an inferior food. The net result is a deficient development of the ovaries, although, by rare exception, worker-bees may appear which have the power of laying eggs, but these workers, being unfertilized, produce only drones.

The queen, on the other hand, has her sexual organs fully developed, and it is the opinion of Leuckart, a German authority, that a good queen has within her 25,000,000 spermatozoa from the male, and during her lifetime will lay 1,500,000 to 2,500,000 eggs. In about a week after emergence fertilization takes place, far from the hive, and high in the air, so that the act of copulation is seldom seen—high up to be clear of enemies, and far away to give unrelated drones a chance to find her, and thereby to prevent inbreeding.

The stages of a queen may be expressed thus:

(1) The egg hatches in three days.
(2) Fed for two days on chyle-food as workers are.
(3) Fed for three days on royal jelly.
(4) Her cell closed up by the bees.
(5) Emerges in seven days (fifteen days in all), a perfect bee.
(6) Mated in seven days (sometimes only five, and sometimes nine or ten days) on an average. The queen mates only once.
(7) Begins to lay in about two days usually.

During their lifetime the queens and drones are fed a chyle-food by the nurse bees. It will be apparent that the queen requires this, since she will frequently lay 3000 eggs per day, and possibly on rare occasions 5000. In other words, she is a laying machine, and has no time for digesting regular bee-food, hence the nurses save her the labor. In the fall of the year in this country, the drones are killed by the nurses withholding the necessary chyle-food.

Parthenogenesis.

If a young queen is debarred in some manner from mating with a drone, she is not always barren, as would be supposed, but some such queens lay drone eggs in profusion, and these hatch into perfect drones. It has been observed, also, that drone eggs laid by a fertile queen have never been impregnated, as female eggs always are. Hence it is true that drones require no father, and always resemble their mothers. It is important here to credit the skilful manner by which Dzierzon, Von Siebold, Leuckart, Schönfeld, and others proved this wonderful fact of parthenogenesis. Our bee-keepers owe the Germans a debt of gratitude for the work they have done in this connection.

Drones.

Despite all that has been said by many authors, the queen is by no means the most perfect in the equipment of the bees of a hive. "The lazy, yawning drone" has more eyes, better wings, and probably better faculties all round, the better to overtake and conquer the queen. Good bee-keepers pay great attention to the quality of the drones in their apiaries.

The workers.

As has been already noted, the workers are "weaned" or imperfectly developed females—amazons, Dr. Warder termed them in the eighteenth century. Weaning has nearly the same effect that gelding has on a horse. It also retards development, so that the worker requires twenty-one days for development from the laying of the egg, whereas the queen needs only fifteen days.

The first duty of a bee is to nurse the larvæ in the cells, cap the cells with wax, and secrete wax ready for comb-building, although this can be done by older bees when required. In ten to fourteen days they proceed out-of-doors to collect honey and pollen in the fields. The young bees are also, as Shakespeare denoted, "singing masons, building roofs of gold,"—i. e., comb-builders.

Swarming.

No satisfactory reason has ever been given for this peculiar phenomenon. Maeterlinck says that it is the "spirit of the hive" which orders it, and this expresses it as well as anything. Our modern bee-keepers dislike this instinct, as it frequently upsets all their nicely laid plans; and it is no exaggeration to say the yield of honey from a modern apiary could be doubled, and even trebled, if swarming could be checked without injury to the stock of bees. The best we can do is to minimize its effect and gently guide the force we can not control completely.

In normal swarming, the colony of bees affected reaches a stage when there is an abundance of food on hand, numerous young bees in process of growth, and all signs of a vigorous prosperity evident on every hand; then, with a wild, pent-up energy, the queen, accompanied by the best part of the bees, fully laden with honey in their sacs, rushes forth, and, after some maneuvering in the atmosphere, they settle on some branch or bush near by, at the same time sending out scouts to find a suitable home in a hollow tree or other receptacle. Then the bee-keeper gives them a hive to live in by simply shaking them into it, or by shaking them down in front of an enlarged entrance-hole. They seem glad to find a home, particularly if it is clean.

Generally speaking, swarms can be handled with impunity without veils, gloves, or smoke, as the bees are in great good humor, unless allowed to hang too long, when hunger sets in.

Fig. 308. An English apiary; and the old-fashioned straw beehive.

Honey.

It is supposed by the general public that honey is gathered by the bees directly from the nectaries of flowers. On the contrary, honey is a prepared food digested by the bees in anticipation of its being used as a food by themselves or young. The nectar of the flowers, as has been proved by Dr. Von Planta, is almost identical with the juice of the sugar-cane plant, and is, therefore, a right-handed sugar; whereas, on the contrary, honey is a left-handed sugar and belongs with the grape-sugar class.

Fig. 309. Straw hives in a French apiary.

It is difficult to explain to a layman what processes the honey undergoes from the time it leaves the flower in the form of nectar. Usually the nectar is reduced to a third or a fourth of its original bulk, and has been "inverted." It also acquires formic acid from the bees, and probably some other ingredients, such as phosphoric acid. Nectar runs as freely as water, whereas honey is very thick, and at a comparatively low temperature turns into a granulated condition—granulates, in fact, at a temperature as high as 65° Fahr. Honey is often sold in Europe in a solid state, and some progress has been made in familiarizing the American market with granulated honey.

Wax secretion.

For a long time the production of wax was involved in mystery; not until John Hunter, the English anatomist, pointed out that wax is a secretion from certain glands in the abdomen of the worker bees, was the matter fairly settled. Huber proved that bees could make a liberal amount of wax if fed exclusively on sugar, showing conclusively that it is a manufacture. A high, steady temperature is necessary for wax secretion, so that our northern bee-keepers are rather consumers than producers of wax. In warm countries wax production is a profitable part of apiculture, and the bees produce it involuntarily, even when no combs are being built. To produce wax in large amount, the bees hang themselves in festoons motionless for

days. Young bees do this work, although old bees can be used in a strait.

Hives. (Figs. 308–320).

The question of what is the best hive is always an interesting topic in apicultural discussions, but this is not the place to enter into a consideration of the relative merits of the various hives now in use in the United States. All our modern hives, however, are based on the hive invented by the Rev. L. L. Langstroth in 1852, which possessed two striking features differentiating it from all others: First, a movable comb-frame having a bee-space on all sides; second, a movable roof. The latter feature is seldom referred to, although, even now, in Germany a movable roof is strongly condemned as unhygienic; but our bee-keeping industry would be poor indeed with a fixed hive-roof. Broadly speaking, then, all our modern hives are Langstroth hives, with small improvements. The original Langstroth was made as shown in Figs. 310, 311.

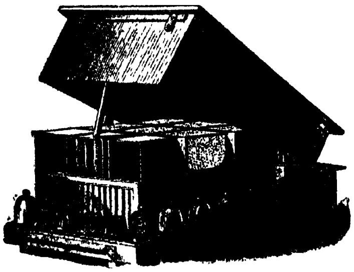


Fig. 310. The Langstroth hive as figured by the inventor in 1859. "Movable comb hive, with full glass arrangement."

The only improvement we have made thus far is in the mode of spacing the frames. In the original Langstroth hive the eye was trusted to space the frames correctly one and one-half inches apart from center to center. It was found in practice, however, that the eye is a poor judge of space; besides, the frames slid about if the hive was moved. The latest and probably the best means of self-spacing is a tin projection which automatically spaces the frames one and three-eighths inches apart. (Fig. 312.) With very accurate spacers we can place the combs still closer, say one and one-fourth inches. Our most common hive is the dove tailed, or lock-cornered; but it is only the old Langstroth hive improved by lock-corners, therefore simpler, easier to make, and far stronger. (Fig. 313.) It may be necessary here to point out that a bee-space is one-sixth of an inch or, if expressed in decimals, .17 of an inch. Between two combs, therefore, one-third of an inch is required to provide sufficient space to let two bees pass.

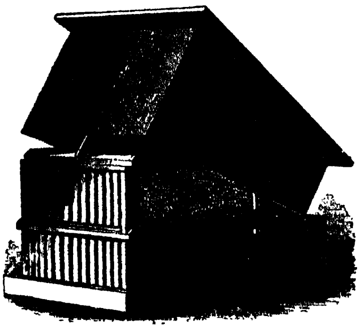


Fig. 311. The hive as pictured by Langstroth. "A perspective view with the cover elevated, so as to show the working of the bees, both in the main hive and the upper honey-box." 1859.

The upper story of a hive is the same as the lower, if the apiarist is running for "strained" or extracted honey. Between the two stories, however, a piece of perforated metal is placed to prevent the queen gaining access to the upper chamber and laying eggs in the combs reserved exclusively for honey. The holes in the metal (zinc) honey-board are so perforated as to allow the workers to pass freely, but not the queen or drones. (Fig. 314–316).

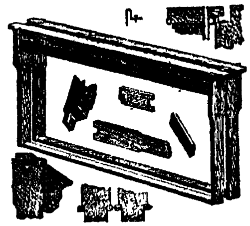


Fig. 312. Self-spacing Langstroth frames.

A hive intended to produce honey in one-pound boxes is entirely different in the upper chamber, and is a triumph of Yankee ingenuity and wood-working skill. In the comb-honey hive the upper story contains a number of small frames which apiarists term "sections" (Fig. 317.) These are termed sections because eight of them constitute a full-sized Langstroth frame. The general public uses the word "box" or "cap" to denote the same thing. To insure regularity these "sections" are arranged with separators or fences between each two rows. These act as guide-posts or plumb-lines to the bees, thereby insuring combs so regular in outline as to resemble so many pressed bricks. This allows of the sections (boxes) being arranged in crates in mathematical order and, of course, are liked by the retailers of honey. It is easier to produce honey without fences being used, and when one sells directly to the consumers there is no necessity for these; in point of fact, some consumers prefer crooked combs as a proof that they were not made by some sort of machine.

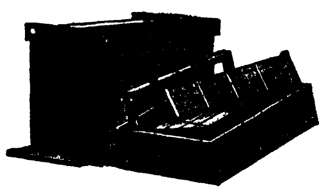


Fig. 313. Standard American hive. Langstroth type.

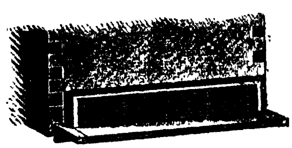


Fig. 314. Marbach entrance, showing drone excluder.

The production of comb-honey in "sections" or boxes holding one pound, is almost a business by itself, requiring an expert knowledge of bees, together with a certain amount of refinement in preparing and adjusting the boxes, and also in preparing them for sale. The European poets have sung the praises of the honey of Mt. Hymettus and of Narbonne, but we are safe in saying that the poets never saw honey that would

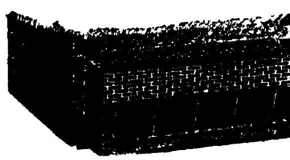


Fig. 315. Marbach-Alley drone trap.

bear comparison with the section comb-honey of America. To see ten or twenty tons of comb-honey in snow-white sections, piled up in a bee-keeper's honey-house, is a beautiful sight.

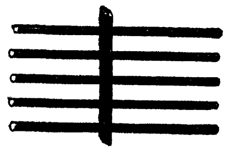


Fig. 316. Marbach wire drone- and queen-excluding metal. One-half natural size.

Comb-honey is now popular in England. Many wealthy persons of America are not so liberal minded, and some are actually prejudiced. Because it is so uniform in appearance, many think it is made by mechanical means, and a canard to that effect has been very extensively circulated by the newspaper press, and has even been copied by eminent authorities on food analysis. This canard has done very great damage to this particular branch of the bee industry. It was thought by bee-keepers at one time that, by offering honey in the comb to their customers, all fear of adulteration would pass away. These hopes have been rudely dispelled. We are safe in saying that all comb-honey is pure, unadulterated honey; and the more beautifully white it is, the better it is in taste, generally speaking.

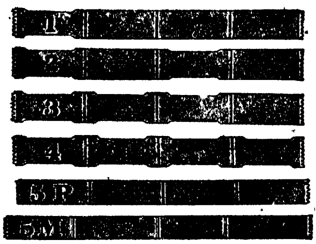


Fig. 317. One-piece basswood comb-sections unfolded. 1, Beeway, commonly called closed top; 2, beeway open top and bottom; 3, beeway open on three sides; 4, beeway open on all four sides; 5 P, plain, no beeways, used with fences; 5 M, plain, no beeways, size 4 x 5 x 1⅜.

The main principle in comb-honey production is to have one's hives abundant in bees on the very day the honey campaign begins, and to have all fixtures in readiness. If the honey is to be obtained from clover or basswood blossoms, the apiarist must be in a position to prophesy fairly the day the blossoms will appear. The chief difficulty the comb-honey specialist has to contend with, is the desire of the bees to swarm; for if a swarm issues, that generally puts an end to the work on the comb-honey supers. To retrieve themselves, bee-keepers capture the swarm and place the upper chamber of the parent colony on the swarm colony. To compel the bees to begin work actually at once, our best apiarists confine the colony to a small brood-compartment, which has the effect of causing the bees to invade the upper chamber at once; once in there, they will proceed to work on the boxes.

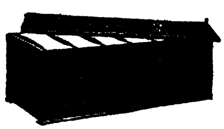


Fig. 318. Farmer's section-box.

A goodly proportion of our apiarists are turning to what is termed the shallow or divisible brood-chamber hives to accomplish this result with the least possible labor. (Fig. 319.) A shallow hive is simply a hive which is shallow in proportion to its length and breadth. Langstroth's hive was ten inches deep, whereas a shallow hive is seven and one-half inches or less in depth, say six inches. The reason for resorting to this kind of hive is that the bees are very loath to enter the small compartments, holding no more than a pound of honey, and compulsion must be used to some extent. To produce extracted or strained honey is easier, as the brood-chamber and upper story are alike; and as there is plenty of room, there is little desire to swarm. By robbing the hives occasionally, the bee-master deprives them of all signs of high prosperity, and this is sufficient to hold in check the swarming instinct, which is, undoubtedly, the bane of successful bee-keeping. Swarming and honey-production are not compatible, and the modern bee-keepers would give a great sum for a method of action which would effectually control it. There are many minds at work on the problem.

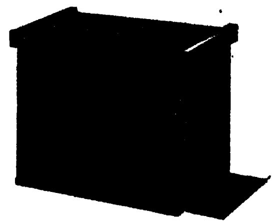


Fig. 319. Divisible brood-chamber, hive and super. The two lower stories for a brood- or breeding-chamber, upper one for honey.

Comb foundation.

The invention of comb foundation marked a distinct advance in American bee-keeping. This is the midrib, or septum, of the comb already prepared by man for the bees to add cells to. It is made by subjecting long sheets of beeswax to pressure in a mold which will yield impressions of a six-sided cell. The process resembles printing except that no color is used. The first foundation-machine was made by Mehring, a German highly skilled mechanic. The old process was to dip thin boards in melted wax, and, when cooled sufficiently, to peel the adhering wax sheets from the boards. The Weed process has largely displaced this practice and is considerably better, because large blocks of wax are "laminated" into sheets very much as steel ingots are rolled into sheet-iron.

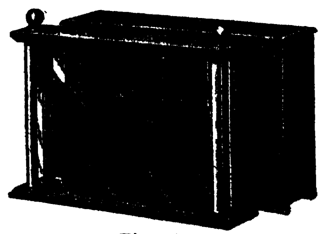


Fig. 320. A type of observation hive.

The skilful use of foundation marks the successful bee-keeper. He uses full sheets of foundation in the brood-frames to prevent the bees building drone-cells, which they will do to the amount of 25 per cent of the space available. To allow so large a proportion of a brood-chamber to be occupied with worse than useless drone-comb is, obviously, a losing speculation; still, it is frequently done. Sheets of foundation properly placed, produce combs so straight and uniform in outline as to resemble so many planed boards. As a result, every comb in the apiary is interchangeable with any other, which represents no small gain. Attention to these details enables our

bee-keepers to attend to a number of hives which would seem incredible to a European bee-master. Full sheets or sometimes only small "starters" of very thin foundation also are inserted in the section comb-honey boxes to insure rapid work, as the bees naturally dislike so small a comb-frame ; but, finding foundation in it, they work it out.

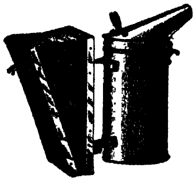


Fig. 321. A smoker.

The honey-extractor. (Fig. 322.)

After the appearance of the movable-comb hive of Langstroth, various aids to bee-keepers appeared, the first of which was Major Von Hruschka's mel-extractor, which removed the honey from combs by centrifugal force. All Americans are familiar with the principles involved. The capping is first removed from the comb by means of a honey-knife, then the combs are placed in wire baskets inside the extractor, the handle of the latter is turned with great rapidity and the honey is thrown from the combs against the side of the extractor.

Our American mechanics have greatly improved the original honey-extractor, until now it is almost a perfect instrument. Occasionally the extractor is turned by engine-power. Centrifugal extractors for wax have also been tried, but none is practical.

Wax-extractor and honey-press. (Fig. 323.)

The most familiar form of wax-extractor is the "solar," working by the sun's heat. It is excellent as far as it goes, but leaves too much wax in the slumgum, or residue, to be termed effective. The latest and by far the most useful wax-extractor is the steam wax-press, in which both steam- and screw-pressure are used to force the wax to part from the mass operated on. It costs considerable, but this is more than counterbalanced by the usefulness. It may be used as a honey-press when the bee-keeper desires to secure a large production of wax. Where the seasons are long, as in the South and West Indies, there is not the same necessity to use combs over again as in the North; and as the price of wax is good, some bee-keepers resort to the practice of pressing out the honey in this press, saving themselves labor and securing a larger production of wax. There can be little doubt that this practice will become popular.

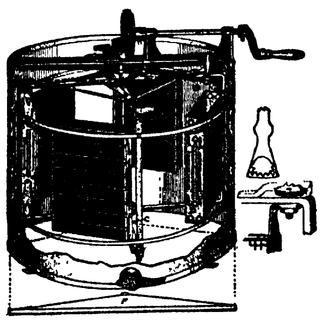


Fig. 322. A modern type of automatic honey-extractor.

Queen-breeding.

One of the absorbing phases of bee-keeping is the rearing of queens. It has assumed large proportions of late years, and there is really more room for very skilful bee-keepers who will undertake this work and do it with scientific thoroughness. But it requires very considerable skill and a complete knowledge of bee-keeping in all its branches to be a really good queen-breeder. The remuneration, however, is excellent for the skilful man. It is almost unnecessary to say that the queen-breeder should locate in the South, in a particularly early locality. Southern Texas takes the lead in queen-breeding matters ; but the whole Gulf coast should be equally good. Our northern bee-keepers would be greatly assisted by the production of queens early enough to put them into colonies which have become queenless during the winter, for these require a mother at the earliest possible moment.

American queen-breeders are famous the world over, and our principal breeders are constantly sending their stock to all parts of the world, even to Italy, the home of our best bees.

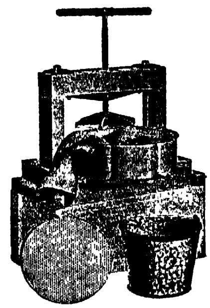


Fig. 323. A wax-press.

The theory of queen-rearing is to have a colony of bees in a condition bordering on madness for want of a queen. In such a condition the bees will accept almost any young larvæ the bee-keeper may provide. They will also accept the artificial queen-cell cups, and provide food in abundance for the young larvæ which have been "grafted" therein. The bee-keeper, on his part, selects larvæ two days old from the combs of the best hive of bees he can find, and "grafts" these into artificial cell-cups to suit his convenience. Natural queen-cells are extremely delicate, and the slightest squeeze injures the immature queen, though an amateur would not perceive the defect. The defect is generally in the wing-structure. There are various methods in vogue. There are two schools—the Alley and the Doolittle—both of which are good, although the latter is the more popular. We can not here enter into a description of the practices now in use. A bulletin issued by the United States Department of Agriculture, entitled "Rearing of Queen-bees" (Bulletin No. 55, Bureau of Entomology, 1905), covers the ground very fully.

When bred and ready for use, the queens are sent in small cages by mail almost anywhere, but it is doubtful whether such queens are as good as those never subjected to the jolts and jars of a mailbag. Some persons now order their queens sent in small colonies of bees, technically a nucleus. This gives the queen a far better chance. One can not be too careful in buying queens to see that the seller has something else than the mere desire to sell queens, as it is so easy to deceive any but the most experienced bee-buyers.

Bees as flower-fertilizers.

Bees are often accused by fruit-growers of being inimical to their industry, when, as a matter of fact, they are absolutely necessary to the success of fruit-culture. Mueller, who is the best authority, made the statement that bees pollinate more flowers

than all other insect agencies put together. It has been proved repeatedly that, without bees, fruit-culture is a precarious business; and, in California particularly, bee-keepers have been asked to return to localities when public opinion had compelled them to abandon the locality. It is a case when familiarity breeds contempt. We are likely to forget that it is the industry of the bee which fructifies the flower, taking the event as a matter of course. If any one doubts this, let him cover up a melon or cucumber plant so that the bees can not reach the flowers.

Enemies and diseases.

Luckily, the bee is not greatly pursued by enemies in the United States, and probably the ignorance and neglect of man are the only sources of trouble. Most farmers who have kept bees and failed, attribute their failure to the wax-moth, when, as a matter of fact, neglect was the real cause. Moths never attack vigorous colonies of bees; hence, the "secret" of success lies in having the bees in prime condition to resist all enemies. The moths are like vultures, coming around when the colony is weak. Very often the colony is queenless, or, if not, lacks food. The remedies are obvious.

Foul brood is a real enemy, and by "foul brood" may be included "black brood," and "pickled brood." We are still very much in the dark as to the cause of the so-called "foul brood." Cheshire attributes it to a bacillus, which he names *Bacillus alvei;* but later investigations have overthrown this opinion, and it is clearly evident that our information on the subject is very faulty. It will be sufficient for us to give the cure (McEvoy method) for foul brood, which is easily recognized by its stinking, noisome smell, and "ropy" condition of the affected brood. The McEvoy method is to take away the combs from a colony and burn them. The colony is given a new set of frames with "starters," which are allowed to stay only four days, when an entirely new set, on full sheets of foundation, are given. The new combs, made in four days, are melted into beeswax, and the treatment is finished. The idea is to deprive the bees of every atom of honey (which conceals the germs), and give the colony a clean, fresh start in life.

Honey-plants.

America possesses a large number of honey-yielding plants, that is to say, plants which secrete nectar in the floral organs, which the bees gather and convert into honey. It is necessary to mention only the more important. In New England, New York and Pennsylvania, clover, basswood and buckwheat may be denominated leaders; but in special localities some other plant or tree may be an important factor, as, for example, the locust on Long Island. In some remote localities the fireweed (*Epilobium*) or the wild raspberry may be important. The culture of sainfoin in the East would be a great boon for eastern bee-keepers; but its extensive introduction seems far distant, although in Europe it is very valuable. [Pages 564, Vol. II.]

In Ohio, Indiana, Illinois, Michigan, Missouri, Wisconsin, Minnesota and Iowa, clover and basswood are the leaders. In some parts of Michigan, fireweed and raspberry give large yields of superior honey, and in other places goldenrod and aster give liberal returns; and on the overflowed lands of the Mississippi, heartsease (*Persicaria*) is an excellent bee-flower.

In the border states, Delaware, Maryland, Virginia, Kentucky, West Virginia and Arkansas, in addition to clover and basswood, there are some excellent honey-producers not common farther north — tulip-tree, persimmon, crimson clover (in Delaware), blue thistle, black gum, Judas-tree, laurel, varnish-tree, magnolia, sourwood, yellow-wood, and others. In North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana and Arkansas, honey-bearing plants are abundant, the leaders being the so-called "gum" trees (*Nyssa* and *Liriodendron*), and cotton, corn, sweet clover (in Alabama), okra, sourwood, sorrel, ti-ti, persimmon, gallberry, with many minor plants. In Texas, similar plants exist; but in southwestern Texas, which is a sort of bee-keepers' Paradise, and a semi-arid region, an entirely different set of bee-plants exists. Catclaw and huajilla are probably the chief, both being species of Lygia; also *Lippia repens*, certain labiate plants, and, where irrigation is followed, alfalfa. In the arid and semi-arid states, alfalfa is the favorite; but the Rocky mountain bee-plant (*Cleome integrifolia*) is very valuable, while the sweet clover growing along the canal courses and by the fence-corners is not despised. The habit of cutting alfalfa before blooming has curtailed the yield from that source during the last few years; still, in Utah and Colorado excellent yields of very high-grade honey are often reported from this source, and the bee-keepers of the Rockies are second to none in ability and enterprise.

Florida stands apart, the leading honey-plants being tropical, namely, false mangrove, palmetto and saw-palmetto, all three being excellent yielders of fine honey when the conditions are proper. West Florida is an exception, tupelo being the main reliance of the bee-keepers. Arizona and southern California form another bee region, with manzanito, madrona, mesquite, black sage and white sage as the leading honey-plants. It is the latter two which have given California a world-wide reputation for honey, in both quality and quantity. Lima beans and alfalfa have proved, however, to be more reliable yielders than wild plants. Fruit-bloom, together with eucalypti and pepper-trees, are also valuable. All things considered, northern California is probably just as good in the long run. In central California, carpet-grass (*Lippia*) and alfalfa are important yielders, with some fruit-bloom.

Ontario and Quebec resemble New York and Ohio in honey-plants, except that thistles are important. In Mexico, on the border at least, in the semi-arid parts, catclaw, huajilla, madrona, manzanito, and century plants are great yielders. In Sonora, the garvanza peas are very important, also mesquite; while in the far South, on the bay of Campeche, the logwood stands without a peer as a honey-

yielder, quality and quantity both considered. The tropics have numberless honey plants.

Cuba has many honey-plants, the leading being the celebrated bellflower (*Ipomœa sidæfolia*), pomarosa, algarroba, and the royal palm. In Porto Rico, the leading honey-producers are the rose-apple (*Eugenia Jambos*), royal palm, coconut, coffee and its shade tree (*Gliricidia*), and a number of fruit trees. The coffee districts are excellent for bees, although but little has been done in scientific apiculture.

Jamaica produces a large amount of honey and wax. Chili is a good honey-producer, from alfalfa principally, and Argentina has taken up the new apiculture in earnest. The giant thistle of the pampas produces honey. In Hawaii, the algarroba is a heavy yielder.

It seems probable that new plants, that is, plants new to our bee-keepers, will be widely introduced in the years to come. Nothing would give greater satisfaction to bee-keepers than to see sainfoin clover widely introduced into the eastern states. In Arizona and southern California, the date promises to become important, and the eucalypti and pepper-tree are gaining ground rapidly. The carob bean, in the Southwest, may become an acquisition, and the garvanza pea, of Sonora, would surely flourish in many sections of the South. Soola clover, also a Spanish culture, would be a great benefit to the Southern bee-master; but the sweet clovers, both white and yellow, grow readily in the South on neglected land, and will probably improve the fertility of the soil. Bee-keepers, generally, object to the laws which class sweet clover as a weed, inasmuch as it is a cultivated plant in Europe, and a valuable soil-improver.

The American tropics possess a wonderfully rich bee-keepers' flora, and it is certainly very remarkable that nearly all the famous timber trees of the tropics are honey-producers. Witness, for example, logwood, mahogany, rosewood, mangrove, divi-divi, lignum-vitæ, teak, greenheart, balata (*gutta-percha*). The great palms, also, such as coconut, date, Palmyra, Carnauba, Royal (*Arenga saccharifera*), Palmetto, the sugar palm (*Phœnix sylvestris*), are all very good, and, in the case of the date, extremely good. It may be stated broadly that trees that are tapped for their sweet juice are also good nectar-yielders for bees. Sugar-cane and corn produce nectar for bees when conditions are favorable, that is, when there is plenty of moist heat. The most remarkable families of plants to bee-keepers in the tropics are the Verbenacæ, Leguminosæ Eucalypti, and Proteacæ, practically all the species of each being honey-producers.

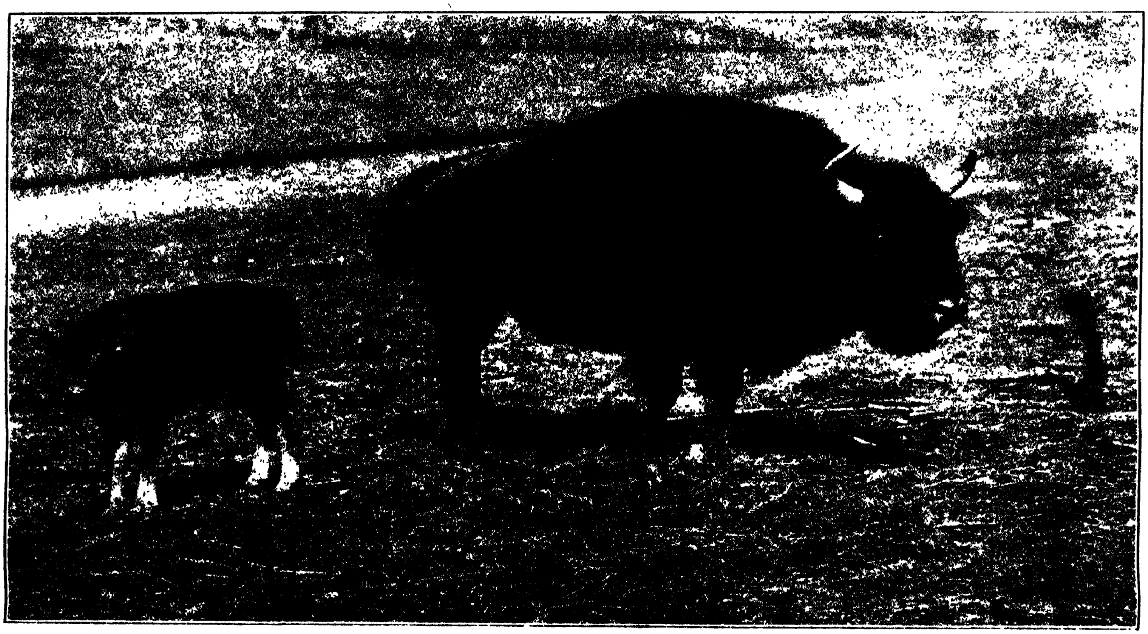
The present position of bee-keeping.

Our American apiculture is in a prosperous state, and the bee-keepers are enthusiastic and hopeful. New inventions making for the improvement of the industry are constantly appearing, and doubtless more will follow; a main need at present is that the subject be given due attention in agricultural colleges. It is unfortunate, indeed, that no agricultural college is at present providing a complete course in bee-keeping. The industry is forcing its attention on the colleges, and sooner or later they must respond.

Literature.

The literature of bee-keeping is very rich and extensive in the English, French and German languages particularly. De Montfort of Luxemburg, writing in 1646, enumerated 600 apicultural authors previous to him, and, of course, there has been a vast increase since his day. Even the American literature is rather extensive, but is nevertheless of high quality, free from the pedantic tendency which is likely to characterize European bee-book authors; and there is but little need of an American student going beyond his own literature of this subject. Space permits mention of only a few references here. D. L. Adair, Annals of Bee-keeping, Louisville, Kentucky (1872); Henry Alley, Thirty Years Among the Bees. The author, Wenham, Massachusetts (1880); Anna Botsford Comstock, How to Keep Bees, Doubleday, Page & Co. (1905); A. J. Cook, Manual of the Apiary, or Bee-keeper's Guide, G. W. York & Co., Chicago, Illinois, twentieth edition (1904); T. W. Cowan, The Anatomy and Physiology of the Honey-bee, Houlston & Co., London, England; G. M. Doolittle, Queen-rearing, Scientific, G. W. York, Chicago, Illinois (1889); W. Z. Hutchinson, Advanced Bee Culture, Flint, Michigan (1905); Harbison, The Bee-keepers Directory, H. H. Bancroft & Son, San Francisco (1861); N. H. and H. A. King, The Bee-keeper's Text Book, The Authors, New York City; L. L. Langstroth, The Hive and Honey-bee, New York (1853); Same, Revised by Dadant, Hamilton, Illinois (1906); C. C. Miller, Forty Years Among the Bees, G. W. York & Co., Chicago (1902); Miner, The American Bee-keepers' Manual, C. M. Saxton, fourth edition (1851); T. G. Newman, Bees and Honey, The Author, Chicago (1892); J. Phin, A Dictionary of Bee-keepers' Terms, The Author, New York (1890); Moses Quinby, The New Bee-keeping, or The Mysteries of Bee-keeping Explained, Revised by L. C. Root, New York (1903); A. I. Root, The A B C of Bee Culture, The A. I. Root Company, Medina, Ohio (1907); G. L. Tinker, Bee-keeping for Profit, The Author, New Philadelphia, Ohio (1880); M. D. Thacher, Bee-keeping, Marsh and Capen, Boston (1829); Dr. H. and Phil Von Ihering, Bulletin of the Museu Paulista, Sao Paulo, Brazil, 1903, 1904, and 1905, on the bees of South America [illegible] honey-gathering wasps—the first real [illegible] grapple with the life-histories of the [illegible]*pona*, *trigona* and *tetrasoma* bees of that continent. Among the magazines devoted to bee-keeping may be mentioned The American Bee Journal (Chicago); Gleanings in Bee Culture (Medina, Ohio); The Bee-keeper's Review (Flint, Michigan); Canadian Bee Journal (Brantford, Ontario); American Bee-keeper (Fort Pierce, Florida). See also various governmental publications, as Frank Benton's Honey-Bee, United States Department of Agriculture (1899); Also a valuable phamphlet on "Queen-rearing," by Phillips; and another on foul brood, entitled "Bacteria of the Apiary," issued in 1907.

A mooly, one-half Galloway, on left, and a three-fourths bison on right, with a full-blood bison cow and calf in center.



A cow, about three-fourths bison, and her Jersey-colored calf

Two half-bred cows

Plate VII. Various forms of cattalo

BISON AND CATTALO. Figs. 324–326. Plates I and VII.

The genus Bison of the bovine family includes the American bison, commonly called "buffalo," and the European aurochs (*Bison bonasus*), together with certain extinct species. Bisons are distinguished from domestic cattle chiefly by their great size, massive fore-quarters, and shaggy appearance. The head is broad and carries short, strong horns that curve upward and inward from the sides of the forehead. The heavy, low-carried head is supported by strong muscles attached to special vertebral processes that rise on the back over the shoulders. These muscles give the neck its heaviness. The fore-quarters are higher than the hind-quarters, which are comparatively light. The tail is short. The coat consists largely of short, curled, crisp "wool." It is shaggiest about the head and shoulders. The face is heavily covered, and the eyes nearly lost; a great beard falls from the throat and chin. The heavy growth of hair continues back over the neck, shoulders and fore-legs, especially in the bulls. Average weights for mature animals are given as 1,000 to 1,200 pounds for cows and 1,800 to 2,000 pounds in bulls. This indicates that the cows are much less massive than the bulls.

Breeding.

In its wild state, the bison was gregarious, traveling and feeding in small companies. At the rutting period, by common consent, great numbers of these scattered bands came together in one vast herd. The mating season occurred in July, August and September, when the herds were on their summer pasture and in the best of condition. At this time there was a fierce struggle for supremacy among the bulls, and the breeding was accomplished only by the strongest. The period of gestation is about nine months, the offspring, usually a single calf, coming in the spring. The American bison will breed in captivity, and is fairly prolific. Some bison cows will produce a calf every year, while, with many others, every other year is the rule.

Bison. *Bison bison*, Linn. (*Bison Americanus*, Gmelin). *Bovidæ.*

By *E. H. Baynes.*

At present, the bison has his strongest hold on the American people by reason of his historic interest. He stands out in bold relief against the most picturesque background the history of our country affords. He is associated with the Indians, with the early explorers and settlers of this continent—with many poetic and many dramatic scenes, such as may never be witnessed again. He is and always must be the leading animal character in the story of America's early days, and for this fact alone the still-remaining remnant of his once mighty race should be carefully preserved.

Of the agricultural value of the bison, however, comparatively little has been said, probably because very little is known. Indeed, it is surprising that so little attention has been given to the commercial uses of an animal so large, so very closely allied to our domestic cattle, and which is known to have been for centuries the chief source of food, clothing and shelter for hundreds of thousands of Indians. Information on this subject in the possession of the writer is very meager, yet it tends to show that, in the hands of intelligent, progressive cattle-men and farmers, the bison might become of considerable agricultural value.

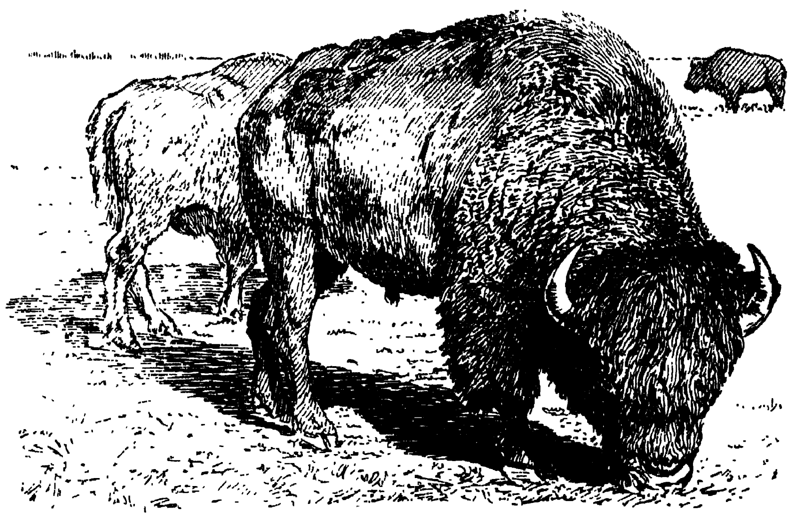


Fig. 324. The American Bison.

For robes and coats.

Undoubtedly the bison product best known and most thoroughly tested is the pelt or "robe." Twenty-five years ago, when the great massacres had almost exterminated the animal, there were hundreds of thousands of these skins in use. Great numbers were made into carriage robes, and a few of these, usually much worn, may still be seen. The writer has never met any one who has used a bison robe who did not speak warmly in its praise; and he has repeatedly been assured by proprietors of livery-stables and others who have had wide experience in such matters that, since the disappearance of the bison hide from the market, they have never seen its equal as a winter carriage robe. Perhaps because of its once great popularity, its name survives in many places where today a winter carriage robe of any kind is referred to as a "buffalo." The prices asked today for "buffalo robes" in good condition, usually range from $50 to $200, according to size and general appearance.

The use of the bison skin as a heavy winter over-

coat was also important. The writer is acquainted with a man who is wearing a bison ulster said to have been in use every season for twenty years. The hair is worn off in many places, but its owner stoutly declares that there is yet ten years' wear in the garment.

For meat.

It is seldom that one has an opportunity to test the quality of bison flesh, but the excellence of this product has been testified to by so many persons in times past that there seems little reason to doubt it. By reason of the peculiar conformation of the bison, no doubt the cuts taken from the anterior part of the body would average comparatively larger, and those from the posterior part comparatively smaller than similar cuts taken from domestic cattle. In flavor and texture, bison meat is said to be indistinguishable from ordinary beef. Occasionally it is seen in eastern markets, and the ultra-fashionable sometimes pay one to two dollars a pound for choice cuts for their holiday menus.

For wool.

Attempts were made to utilize bison wool, but the failure of the supply of raw material put an end to experiments in this direction. As is well-known, bison grow a very heavy winter coat, which is shed in patches during the following spring and summer. This coat consists chiefly of brown wool, which, if properly clipped, would probably prove a valuable product. In 1905, the writer collected some of this wool, and submitted it to several woolen manufacturers, all of whom were keenly interested. One of them had the material thoroughly tested in his mills, with the result that he found it stronger, grade for grade, than sheep's wool, and that it felted beautifully, which his foreman had assured him it would not do. This manufacturer expressed the opinion that if bison wool could be secured it would for a time demand a very high price as a novelty, and that afterward, if it proved durable, there would be a good market for it, for the manufacture of gloves, stockings and other articles not requiring to be dyed the lighter, brighter colors.

It is likely that the best method of shearing a bison would differ somewhat from the methods now employed in shearing sheep, but that the operation would present no serious problems to an up-to-date cattle-man, is reasonably certain.

For draft.

That bison can be broken to the yoke, if taken young, is a fact that has been demonstrated frequently. The writer has a team of bison oxen, which he reared on cow's milk from the age of three weeks, and which now, at the age of three years, are still tractable in yoke or harness. They were not so easy to break as domestic steers, but are capable of much greater speed, and are probably stronger, weight for weight. There is no doubt that, at any work in which the chief requisites are speed and endurance, bison would prove much superior to domestic oxen.

Rearing.

The "artificial" rearing of bison calves is a simple matter, if they are taken from their mothers when not more than two weeks old. They will suck a domestic cow, or drink from a bottle, a pail, or an ordinary calf-feeder. One fairly good fresh cow will supply milk enough for two bison calves.

Most of the calves are born in April and May. They are remarkably strong and vigorous, and within a few minutes are ready to fight if interfered with. They are tawny reddish in color, the shade varying greatly in different individuals. In the course of a few weeks, dark brown hair is seen replacing the natal fur in places, often on the face and in a line down the middle of the back. By the end of the summer all but the late calves are clothed completely in the dark brown pelage of the adult animal.

On the range, buffalo calves suck their mothers for the greater part of a year. In the Corbin Game Preserve, in New Hampshire, the writer has watched them nursing until December, at which time they are separated and yarded for the winter. It is not unlikely that this accounts, at least in part, for the fact that their mothers sometimes come in poor and thin and perhaps unfit for service the following summer. It occurred to the writer that, if the calves were weaned as domestic calves are weaned, the cows would probably produce offspring practically every year, which is not the rule at present, although some cows do, even under existing conditions, produce a calf every spring for several years in succession.

Although so fond of milk, the little fellows begin to sniff at and nibble the grass blades within forty-eight hours after they are born. They are much wilder than domestic calves, and, if weaned, care must be taken that they do not injure themselves. One of a number of calves weaned by the writer leaped against a fence post and broke a fore-leg. Such accidents can be avoided by keeping the youngsters in pens fifteen or twenty feet square with solid board walls, for a few days until they get used to the presence of those who are to care for them.

As is well known, the bison can thrive with conditions under which domestic cattle would perish. His warm robe as well as his general conformation enable him to weather storms and low temperatures which would be fatal to range cattle. He can also forage for himself under very trying conditions. In a climate like that of New Hampshire, however, where the ground is apt to be covered with deep snow from November until March, they require feeding for about five months in the year. In the Corbin Preserve, where, at this writing, April 1, 1908, there is a herd of 137 head, the animals are yarded during the winter and early spring, and fed on hay. According to William Morrison, who has had charge of this herd for many years, a calf in its first winter consumes about half a ton of hay. Each succeeding winter, he states, it eats about half a ton more, until a maximum of three tons is reached. No other food whatever is given, but running water is accessible

at all times. For full information on this subject, the reader is referred to an article entitled "A Great Buffalo Herd in Winter Quarters," published in "Suburban Life," February, 1906.

Bison, however, will eat almost anything that domestic cattle are fond of. The writer has tried them with corn meal, "middlings" and mixed feed, and they not only ate what was given them but would walk into the barn and steal the food at every opportunity.

Bison naturally are not vicious animals, though now and then a bull develops a bad temper, and many of the cows are very waspish when their calves are young. However, thousands of visitors pass through the Corbin Preserve every summer, often close to the herd, and, from first to last, hundreds of men have been employed there, yet, with one slight exception, no one has ever been injured by a bison. The exception occurred some years ago, in the bison yards, when a cow, in defence of her newly-born calf, chased William Morrison, and, as he was retreating over the fence, pinned his leg to the boards. It should be added that this man is in the habit of taking unnecessary risks, and that the writer has known him to be more seriously injured by other kinds of animals.

Among the good points looked for in an adult pure-blood bison bull, may be mentioned, great height of hump, massive front, broad forehead with deeply-curved horns, which should be of great diameter at the base and taper rapidly to a point, and a short tail. The space between the horns should be filled with long, black hair, which will sometimes almost hide the horns themselves. A heavy growth of similar hair on the fore-legs also adds greatly to his appearance. The amount of hair will vary from year to year, even in the same individual, but the more there is the handsomer he will be.

The bison cow is not nearly so fine-looking as the bull. Her hump is not so high, and usually she presents a much less shaggy appearance. Her horns are much smaller at the base and taper much more gradually.

Cattalo.

The cattalo is a hybrid between the native bison and the domestic cow. The bison is the one native American quadruped that gives promise of contributing any important share to agriculture ; and even this noble animal has not yet been domesticated or bred for agricultural purposes. He is now a park animal. The most promising attempts yet made to preserve the bison in any economic relation is by combining his blood with that of domestic cows. Even this experiment has not yet gone far enough to enable us to arrive at anything like a conclusion as to the ultimate merits of the hybrids. The experiments have been scattered, mostly haphazard, and all of them without real scientific study and control. Under such conditions it is not strange that there are the most diverse opinions respecting the future of this race of animals. Many obstacles have developed in the breeding of these hybrids, but the difficulties will probably not prove to be insurmountable when we once come to study the subject carefully, on the basis of well-planned experiments. It will be rather an economic question, whether they will be really of sufficient superiority to common cattle in any respect to make their breeding worth while.

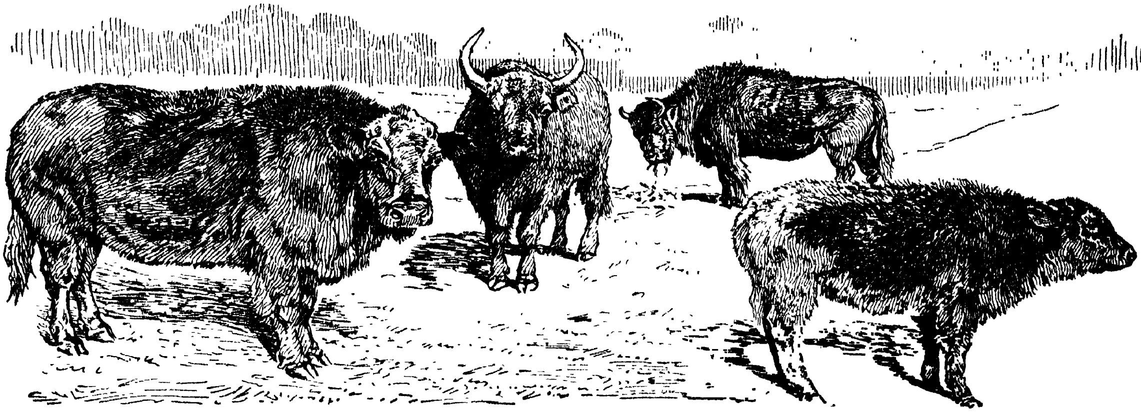


Fig. 325. Cattalos. One-half Galloway on left, with her three-fourths calf in the foreground; in the middle, a possibly one-half cow; and, beyond and above the calf, a three-fourths cow.

The chief prospective value of the cattalo is as a range animal, under conditions in which common cattle do not thrive. Some persons think that, with the passing of the unfenced ranges, the usefulness of the cattalo will be small. Others, however, think that the cattalo may compete with cattle in conditions under which cattle thrive, in the production of valuable robes and of a greater quantity of meat. It is probable that the animal will be adaptable and valuable chiefly in inhospitable places where cattle yield small returns, and in the larger half-wild ranching of the West and North.

There is no recognized or authoritative spelling of the word that designates this group of hybrid animals. Such combinations as cattlo, cattloe, catalo, catalow, cattalow, cattelo, are more or less used. The name, under any spelling, is yet unknown

to the lexicons and encyclopedias. It is now proposed to adopt the spelling *cattalo*, as being best in form, most conformable to the two words from which it comes (cattle and buffalo), and perhaps more euphonious. This word is here used to designate all hybrids of bison and cattle of whatever blood and

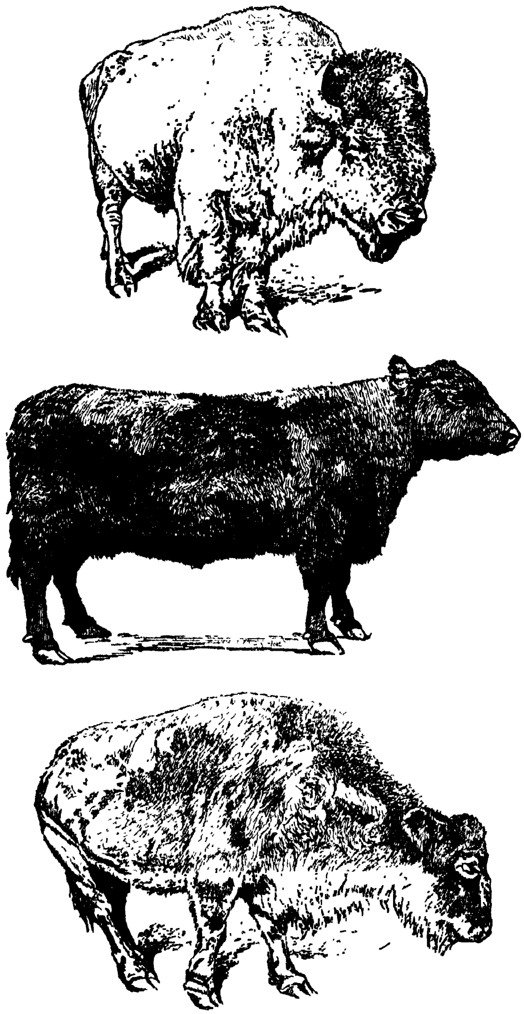


Fig. 326. At top, a bison bull; a Galloway cow; a direct hybrid between a bison bull and a Galloway cow.

whichever parental way the cross is made. The accent is on the first syllable, as in buffalo.

There are no recognized authoritative sources of information on the cattalo. The following facts have been gleaned by the Editor from an extensive correspondence and inquiry on the subject.

Description.

The cattalo is characterized by large size, being heavier than either race from which it comes, great hardiness, and rather remarkable feeding qualities. It is also said to be gentle and easily handled. Individuals vary greatly in form; some of the half-breds are straight on the back and as square as Shorthorns, while perhaps 50 per cent will have half humps and resemble the bison in general conformation. The color depends somewhat on the parentage. Crossed with Galloway or Aberdeen-Angus cows, the hybrids come either brown after the bison, or black, after the mother, more commonly the latter. A small percentage come perfectly brown. The "fur" is more dense than that of the bison, particularly on the three-fourths and seven-eighths bison hybrids; and, instead of the shaggy shoulders, the fur is equally distributed, being nearly as long on the rump as on the shoulders. It is a beautiful glossy coat, said by some persons to be more handsome than the coat of the pure-blood bison. The cattalo has the voice of the bison.

The hardiness of cattalos is indicated by the fact that they can live entirely in the open, winter and summer, with no feed but grass. In the winter they dig in the snow for food. Especially noteworthy is the fact that they face storms and blizzards, and never leave the plains to seek shelter; hence, storms will not drift them. They can thrive without water for three days at a time, so that they can herd at a distance from streams. They herd in droves instead of separating as do domestic cattle.

History.

From a very early date it has been known that the American bison could be domesticated. As early as 1701, according to Hornaday (The Extermination of the American Bison, Smithsonian Report, 1887), the Huguenot settlers at Manikintown, on the James river, a few miles above Richmond, began to domesticate bison. In 1786, or thereabouts, bison were domesticated and bred in captivity in Virginia, and it is said that in some of the northwestern counties the mixed breed or hybrid was common. In 1815, a series of experiments in cross-breeding the bison and domestic cattle was begun by Robert Wickliffe, of Lexington, Kentucky, and continued by him for nearly thirty years. In 1877, S. L. Bedson, of Stony Mountain, Manitoba, secured a young bison bull and four heifer calves, with which he later undertook to produce hybrids on domestic cattle. In 1880, Charles Goodnight, of Goodnight, Texas, roped four bison calves from the scattering wild herds, which he raised and bred on domestic cattle. From this start he now has seventy head, and during this time he has disposed of about twenty-five or thirty head. In 1885, he began crossing bison bulls with Aberdeen-Angus cows. In 1885, C. J. Jones, of Topeka, Kansas, who has been recognized as a leader in the efforts to establish the cattalo, purchased his first hybrid calves in Manitoba. These are still alive. In 1887, the first hybrid calves were born in his herd. Both Goodnight and Jones have continued their efforts to the present time. The success attained by these early breeders in securing what seemed to be a valuable hybrid, led many persons to take up the experiment, and today efforts are being made in many parts of Canada and the United States.

The statistics of bison and cattalos as recently completed by Dr. Hornaday are as follows:

AMERICAN BISON, OF PURE BLOOD.

	Males	Femal's	Calves in 1907	Total on Jan. 1, 1908	Total in 1903
Captive in the United States .	506	610	203	1,116	969
Captive in Canada	214	262	98	476	41
Total in America	720	872	301	1,592	1,010
Captive in Europe	54	76	22	130	109
Total in captivity	774	948	323	1,722	1,119
Wild bison in the United States, estimated . .	. .	. .	. .	25	. .
Wild bison in Canada, estimated.	. .	. .	. .	300	. .
Total pure-blood bison, Jan. 1, 1908	. .	. .	. .	2,047	. .
Number of owners of pure-blood bison, in America . . .	. .	. .	. .	45	. .
Number of owners of pure-blood bison, in Europe.	. .	. .	. .	19	. .

BISON-DOMESTIC HYBRIDS, OR CATTALOS.

	1907	1903
In the United States	260	243
In Canada	57	17
In Europe	28	21
Total on January 1, 1908	345	281

Breeding.

The object of the breeders of cattalos seems to have been to preserve the hardiness and rustling qualities of the bison in an animal that would easily be domesticated and would yield a large quantity of good meat; and at the same time to secure a valuable pelt. There is need for a domestic meat-producing animal adapted to elevated and cold regions, as in the Rocky mountains and Alaska. If a breed of cattalos can be established, it promises to meet the need.

The early breeding efforts,—and the same is true in a measure of the recent efforts,—were attended with considerable loss and discouragement. The domestic bull will not cross on the pure-blood bison cow, so that the cross is restricted to the use of bison bulls on domestic cows. It was difficult to get hybrid calves, and many domestic cows were sacrificed in the effort. Hiefers that conceived, died. Domestic cows carrying a half-bred bull calf, either aborted or died. Mr. Jones estimates that in his early experiments he got one hybrid to every thirty cows bred to bison bulls.

In 1893, he was able to secure 60 per cent of the calves. Notwithstanding these setbacks, the experiment has been continued until the feasibility of producing and rearing cattalo cows has been established. These hybrid cows are more prolific than bison cows, and breed equally well to the domestic bull and to the bison bull. There seems to be no evidence that fertile hybrid bulls have ever been produced in the first cross; and very few infertile ones have been born and lived as a result of the first cross. The reason assigned to the inability of the domestic cow to produce a male bison calf is, that even in the half-bred male animal, the spinal processes of the dorsal vertebræ are so high that the pelvis of the domestic cow does not admit of their passage through. It is also said that the body of the domestic cow "fills up with water," especially if she is fat, which makes difficult parturition. By crossing the half-bred cows back to the pure-blood bison bull, both male and female calves are produced.

James Philip, of Fort Pierre, S. D., who has a large herd of bison, says that some of these ¾ bulls are fertile, while a very large percentage of the ⅞ bulls are fertile, either ⅞ bison or ⅞ domestic. Mr. Jones states that the greatest amount of bison blood he has been able to get in a fertile bull is ½. He has not yet bred his ⅞ and $\frac{15}{16}$ bison bulls, and is unable to say whether they are fertile or not. He finds that about one-third of the ¾ bison hybrids are bulls, while a larger percentage are males in the ⅞ bison hybrids; and the same is true as we approach the domestic bull. N. E. McKissick, of the Union Stock Yards, South St. Paul, Minn., who bred cattalo for James J. Hill, writes:

"Hybrids breed among themselves, although they are not nearly so sure breeders as full-bloods or hybrids on full-bloods. By crossing full-blood bison bulls and hybrids, the results are the same as in breeding grade cows to a full-blooded sire; further crossing improves the grade. Breeding a domestic bull with a bison or hybrid cow is not nearly so successful as breeding a full-blood bison bull to domestic cows, and it is only a small percentage of domestic cows that will breed with bison. In our hybrids we had just about the same percentage of males and females. I used a three-quarter hybrid bull on Mr. Hill's herd, and cannot see but that I got just as good results as I did with a full-blooded bison bull."

Michael Pablo, of Ronan, Montana, also states that the hybrids will breed among themselves. He has had considerable experience in handling bison, and has delivered 400 head of bison to the Canadian government.

The Mossom Boyd Company, Bobcaygeon, Ontario, began a careful series of experiments in crossing bison and domestic cattle, more especially Aberdeen-Augus and Herefords, in the year 1894. The results of these experiments to date were presented to the American Breeders' Association, at its fourth annual meeting in January, 1908. The following extract is made from that report: "I would tentatively list the following characters as dominant: The whole body-color of the bison;

the white face of the Hereford; the polled head of the Augus; the hump of the bison, dominant but somewhat modified; the width of the hind-quarters of the beef breeds; the width in front of the beef breeds; the voice of the bison. As to whether the period of gestation in the bison differs in length from that of the domestic cow, I do not know, but in the case of thirty-nine successful hybrid births, the time varied from 244 to 277 days, with an average of 264 days, which is an ordinary period for the domestic cow, although somewhat shorter than the average.

"Thirty calves of the second generation comprised twelve bulls and eighteen females, or 40 per cent bulls, as compared with 15⅓ per cent bulls in the first cross. Some of these calves were sired by domestic bulls, and are consequently one-quarter bison; others were sired by pure bison bulls, and are therefore three-quarters bison. The one-quarter and three-quarters bison are markedly different from the half-bloods. The one-quarter bison very much resemble domestic cattle, and the three-quarter bison are nearly like pure bison.

There is difference of opinion among breeders as to how long the bison characters will hold when the hybrid cows are bred to domestic bulls. Mr. Pablo thinks that if the domestic bull is used on the third generation the bison characters will largely disappear. Some of Mr. Goodnight's animals, with only one-eighth bison blood, showed bison characters. Others think that four or five crosses would be necessary to eliminate the bison characters.

The best results seem to follow the use of Galloway and Aberdeen-Angus cows for crossing with bison bulls. Hereford and Shorthorn cows have been used, but with less satisfactory results. A good result of choosing the solid black cows is that the hybrids have a rich dark coat without streaks.

Distribution.

The distribution of the effort to breed cattalos is very wide. The largest number of hybrids are to be found in Montana, Texas, Arizona, California, South Dakota, Ontario, Minnesota and Oklahoma. They are represented by greater or less numbers in Iowa, Michigan, New York, North Dakota, Alberta, Utah, Wyoming and Quebec. They are also to be found in England and Russia.

Feeding and care.

The cattalo requires little feeding or attention, and will make more rapid gains on the same food than will domestic cattle. It requires no shelter, winter or summer. Ordinarily, no artificial feeding is necessary. The cattalo has very thorough digestion; as a result, the manure is said to be of little value. One of the greatest difficulties in breeding cattalos is that they are usually too fat.

Use.

For robes.—There seems to be no difference of opinion in regard to the excellence of the robe from a cattalo, especially when the cross has been made with a black domestic cow. The robe is rich and glossy, large and durable, and commands a high price on the market, perhaps twice as much as a "buffalo" robe. The "fur" or hair is of a soft and pleasing texture. The value of the hides varies from $75 to $200, and may be more.

For meat.—The meat from the cattalo is said to be excellent and to resemble domestic beef somewhat closely. The carcass is heavy, and the calves fatten very readily. The meat brings a high price, sometimes selling at $1.25 to $2 per pound by the quarter. James Philip reports the sale of a cattalo, which dressed over 900 pounds of excellent beef.

BUFFALO or WATER-BUFFALO. *Bubalus bubalis*, Lyd. [*Bubalus buffalus*, Blum. *Bos bubalus*, Brise. *Bubalus bos*, Watt (tame B.). *Bubalus arni*, Ken. & Shaw (wild B.)]. *Bovidæ.* Bubalus (Latin), Boubalos (Greek), Büffel (German), Buffle (French), Bhains, Bainsha (male), Mhains (female) Arna (wild B. male), Arni (wild B., female), (Hindu), Moonding (Soudan), Karbo or Karbou (Malay), Carabao (Philippines). Figs. 327, 328, Plate VII, Vol. I.

By *F. Lamson-Scribner.*

The buffalo is a draft animal of the bovine family, also valued for its milk, hides and horns. The millions of Orientals, whose chief and often only diet is rice, are largely dependent on the water-buffalo in raising their supply of this cereal. In fact, this is the only animal the natives of the low and humid regions of India, China and the Philippines can use to cultivate the great rice-fields of those countries while covered with water — a system almost universally practiced. The buffalo loves to wallow in mud and water, and its home is in marshy districts and along the river-bottoms in regions of high temperature and heavy rainfall; and there it is as useful to the natives as are the dromedary and camel to the inhabitants of the dry and desert regions of northern Africa.

Description.

The water-buffalo is the largest of the Bovidæ, measuring, in the larger breeds, up to six and one-half feet in height at the shoulder, and ten feet in length from the muzzle to the base of the tail; body well rounded and large of girth; withers sharp and elevated; shoulders well formed; hind-quarters less well developed; thighs thin; head comparatively small; muzzle large and carried well forward; limbs short and massive; horns large and much flattened, or somewhat triangular toward the base, deeply ringed, directed backward or downward, finally curving upward or inward and becoming scimiter-shaped, usually very long, sometimes attaining the length of five or six feet; tail short, reaching to the hocks; skin a very dark bluish or grayish black, rarely brownish or dingy white, thinly covered with coarse black hair; hair on the forehead and knees more dense; young calves well covered with brown hair all over. The color of the water-buffalo is not unlike that of the elephant, and their motions are similar; the resemblance is so striking that a casual view of a moving herd of buffalos suggests a roving band of elephants.

There are other species of buffalo aside from the one that we are now considering and which is the buffalo of history. The best known other species is the African buffalo (*Bubalus Caffer*), which is not domesticated in American territory. In America the word buffalo is commonly but erroneously applied to the bison (which see).

History.

There is no doubt that the domestic breeds originated from the wild buffalo of India, but when domestication began, or at what periods these animals first appeared in the countries where they are now common, is doubtful or unknown. It is said that they were introduced into Italy in the sixth century, and into Egypt some time prior to this period. They were in the Philippines when those islands were first visited by the Spaniards; but further than this, little is known of their origin or history.

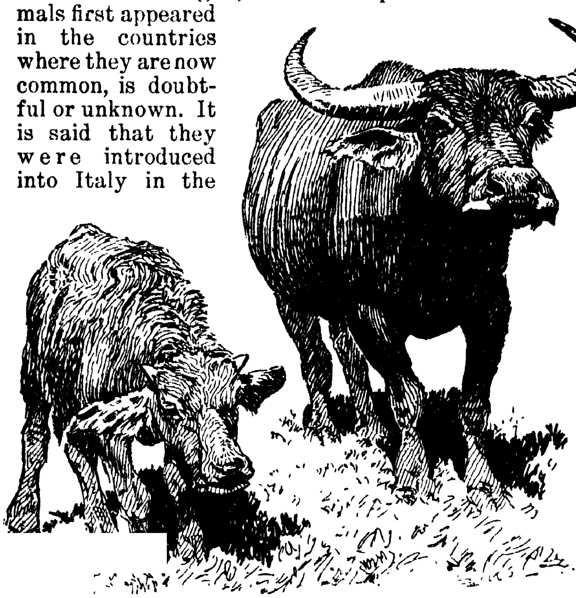


Fig. 327. Buffalo cow and calf. Philippine islands.

Distribution.

From India, where small herds of wild buffalos are still found in the grassy jungles along the great rivers and in the open moist prairies — the finest occuring in Assam and Burma — the domesticated animal has spread, in comparatively recent times, through southern China, the Straits Settlements, Java, Ceylon, Sumatra, Borneo, and the Philippine islands. To the westward, it has extended to southwestern Asia, Africa, along and far up the Nile, and to the countries of southern Europe. Great numbers are kept on the bottom lands of the Danube, the Theiss, and the Drave in Austria-Hungary, and in Italy, on the plains lying to the north and east of Naples. In this last region, known as "Terra di Lavoro," it is reported that there are 12,000 buffalos, bred mainly for their milk for cheese-making. The cheese is all consumed locally, as it is not adapted for export. Small importations have been made into Algeria and Cape Colony. In one importation into South Africa, it is recorded that two or three animals of the consignment soon died from "heart-water," a disease induced by the tortoise-shell tick, common in Cape Colony.

Buffalos, of what appears to be the Jafarabadi variety, have been introduced into Trinidad, South America, where they are used as draft animals and are worked entirely by Hindu coolies. There are about thirty of these buffalos on the sugar estate of Mr. L. Bert de Lamarre, at Tacarigua, and a smaller herd at Chaguana. They are fed the ordinary forage of the country, with the addition of a little coconut-meal and molasses; they breed freely on both estates; they are not troubled by ticks or other insects, and, while an occasional animal may show dangerous tendencies, as a rule they are very docile and easily managed. They enjoy but do not seem to require a daily bath. [This information relative to the buffalo in Trinidad has been furnished the writer by O. W. Barrett, of the United States Department of Agriculture.]

Breeds and types.

In India several breeds are recognized, but in some cases their characters do not appear to be defined very clearly, while in others the recognition is purely local. Watt (Dictionary Economic Products of India) recognizes the following five breeds:

(1) *Jafarabadi* or *Nadhiali*, distinguished by the remarkably large frontal bones, short, broad, much flattened horns, which are directed sharply backwards and downwards, then abruptly upwards, so that the points are turned inward (horns in the males sometimes eight inches broad at the base); body very large and well set; temperament mild; cows noted for their great yield of milk.

(2) *Ramnard.*—Horns of medium length, flattened, directed backwards, curving inwards toward the tips; body low, thick set and deep chested; hair brown or dun-colored; cows good milkers. This is an excellent variety, belonging to the Madras breed, and is found in the district lying to the southeast of Madura (Wallace).

(3) *Gujarat*, *Talabda* or *Gaujal.*—Much smaller than Jafarabadi buffalos, with comparatively short horns; milk limited in quantity but richer than in other breeds.

(4) *Nagpur.*—Horns remarkably long, sweeping downwards and backwards and then upwards; bodies low, massive and well set; hair black; males usually very large and used for hauling heavy loads; cows excellent milkers. This breed is very similar to the long-horned Bombay buffalos and is probably identical with that breed.

(5) *Deccani.*—Horns of medium length, directed backwards, downwards and then upwards, nearly in the form of a half circle; hair brown or chestnut. This breed is comparatively small and very hardy. The cows are fairly good milkers.

Kundi or *Khundi*, according to Wallace, is a name applied to a local breed that is kept for milking purposes in the neighborhood of Cawnpore. It is probably only a form of the Jafarabadi buffalo.

The *Madras buffalo* is a small, inferior variety with horns of medium length, black skin and light gray hair. *Cinghalese buffalos* resemble the Madras breed and are even worse milkers. The *Palia* variety, from the Nariad district, is small and resembles the Talabda, but is more hardy. A local breed of the Southern Maratha country is the *Jowari*, medium in size, with rather long horns, skin usually black, but sometimes brown or chestnut, hair usually dun or dull white. The *Toda* buffalos of the hill district near Utakamand are low-set, massive, long-horned animals noted for their superior milking qualities. Fairchild (Bulletin No. 27, Bureau Plant Industry, United States Department of Agriculture) refers to the excellent milking qualities of the *Delhi* buffalos from Delhi, India, and the *Surti* variety from Gujarat. The former yields over thirty pounds of milk per day, and sells in Bombay for $56, gold; the latter yields about twenty pounds of milk per day and sells at $33 to $36, gold.

The different breeds of buffalos vary in size, the largest, weighing 1,600 to 2,000 pounds, occurring in Assam, while the smallest are found in Madras, where occasionally they do not exceed thirty inches in height when fully grown, and are correspondingly light in weight. This variation is due largely to good care and some attention to correct principles of breeding in the one case, and lack of all care and attention in the other. Environment has played an important part, also, in the development of the breeds as they exist today. The conditions in Assam are evidently favorable to large growth of bone and muscle, while the drier and less favorable climate of Madras has tended toward the production of a race of dwarfs. The milking breeds are doubtless the result of long and careful selection, and the enormous development of the frontal bone in the Jafarabadi buffalos, so abnormally increased in some cases as completely to cover the eyes, is solely the result of artificial selection for the purpose of increasing the strength of the skull, in order that they may withstand the rush of combat. These animals fight by butting, and owing to their great weight and enormous strength, the shock of a well-directed charge is terrific. The backward growth and curvature of their horns renders these useless in thrusting or piercing, and buffalos depend on their immense ramming power to stun or overthrow an adversary.

The wild water-buffalo is generally larger and better developed than the domesticated breeds, with longer horns, and is far more active in its movements; some authors have treated it as a distinct species. It is one of the most formidable and dangerous of the big game of India, quite a match for the Bengal tiger, and in a charge will sometimes overthrow an elephant, on which animal buffalos are hunted. This superiority of development in the wild breed is due doubtless to natural selection, the largest and strongest males driving away or killing the weaker bulls in the rutting season, and taking full possession of the cows in their immediate localities. Wild bulls sometimes invade domestic herds which may be in the neighborhood of their native haunts, and, appropriating the females, impart their superior qualities to their progeny. This has been offered as an explanation for the excellence of the Assam buffalos over those breeds in regions far removed from the wild stock. When roused, the domesticated animal, ordinarily very docile, becomes hardly less dangerous than its wild parent of the jungles. Formerly the Jafarabadi buffalos were bred to supply animals to fight in the bull-rings of the Indian rajas.

In general, it may be said that very little effort or care is taken to maintain distinct breeds or to keep pure those that are somewhat clearly defined, and in consequence there is more or less confusion in regard to their characters and limitations. This is manifestly the case in the Philippines, where the buffalo, or carabao, as it is called throughout the islands, is valued almost altogether as a beast of burden, cows and bulls being everywhere worked

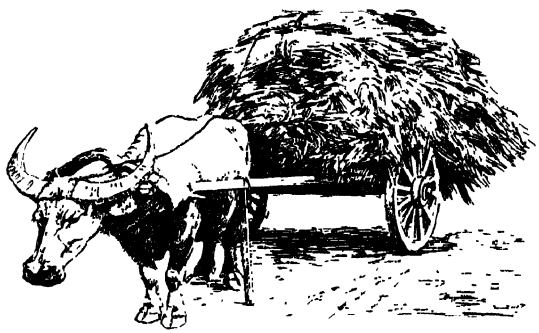


Fig. 328. Carabao with load of rice straw. Philippines.

indiscriminately. There is no evidence of any effort having been made to improve the stock, or any recognition of distinction in breeds.

Feeding and management.

In buffalo countries stabling is little thought of and hardly needed, the animals being kept in the open or under the shelter of bamboos or friendly trees, rarely under a roof of any kind. Little attention is given to their feed, which usually is limited to the coarser grasses on which they are allowed to graze, with an occasional feeding of rice or "paddy" straw when pasture is insufficient or inaccessible. When grazing where there are cultivated crops, buffalos are usually guarded by boys, and the relation between the beast and the boy is often one of manifest affection, and sometimes even jealousy is shown on the part of the animal. It is a common sight in the country to see boys sitting on the backs of the buffalos while they are quietly grazing, and directing the animals by the nose-strings, should they attempt to pass out of bound. Buffalos become much attached to their little herders, following them about like a dog, and becoming active protectors in case they are exposed to danger.

Working animals are driven or guided by a long rope, that is fastened to a ring in the nose, and then passed around the horns to the hand of the driver. In some cases the nose-ring is omitted, the

rope being fastened only to the base of the horns. Jerking on the rope, in ways understood by the animal, serves to direct his course, or hasten his motions. Buffalos are usually driven single or tandem; rarely are they yoked in pairs.

In the middle of the day, when the weather is hot, buffalos will lie for hours in pools or streams with only their horns and faces above the surface. When the water is not deep enough completely to cover their bodies, they will dip their heads below the surface, then suddenly raise them, causing a stream of water to flow over their exposed backs. If kept too long from their accustomed water or mud bath, the working animals become unmanageable and dangerous, and if near a pool will break away from the driver and rush into it. If kept too long in the hot sun away from water, death of the animals may result.

The buffalo is distinctly the brown and yellow man's beast of burden; it has no friendship for the Caucasian, and instances are cited when animals that would permit all manner of liberties from brown and half-naked Filipino children, would become excited on the approach of a white man to the point of attacking him viciously. The American or European who attempts to drive a carabao may quickly find the relations reversed, and be forced to seek safety in flight.

Telling the age.

The age is judged by the condition of the incisor teeth, which is much more reliable than by the number of rings on the horns. At the age of ten months the young buffalo has a full set of eight milk incisors in the lower jaw. In the third year the central pair is replaced by two permanent teeth; two more permanent teeth appear in the fifth and two in the sixth year. In the seventh year, the last of the milk incisors disappear, and when the animal is eight years old the incisors are permanent, the earlier ones being much worn. At twelve years, the "uncertain age" has arrived, and beyond this period it is impossible to determine how old the animal may be.

Uses.

For milk, butter and cheese.—Certain breeds of buffalos are noted for the abundance and richness of the milk that they yield, and are kept almost solely for dairy purposes. Such are the famous Jafarabadi or Bombay buffalo, and the Talabda or Gujarat. When well cared for these animals will yield thirty to forty pounds of milk, making one to two pounds of butter per day. In some localities, the whole milk is used in manufacturing cheese, which is said to be of fairly good quality. The yield of milk of the Italian buffalo cow averages fourteen liters per day [a liter is about one and three-fourths pints], which, used whole, will make nearly three kilos of cheese. The milk has a bluish tint, and to the European or American taste a slightly musky or insipid flavor, but it is rich and the yield per animal is nearly twice that of the cattle of the same region. Buffalo's milk is remarkably rich in butter-fat, amounting to nearly twice the percentage of that of a good Jersey cow. The following are recorded analyses of the milk, the first being from buffalo cows in Italy, the second from cows in India:

	Italian Per cent	Indian Per cent
Water	82.2	82.05
Fat	7.95	7.99
Casein	4.13	4.00
Milk-sugar	4.75	5.18
Salts	0.97	0.78
	100.00	100.00

All attempts to raise the milking breeds of cattle of western Europe, or of the United States, in the tropical countries best suited to the buffalo, have proved to be complete failures. Attempts at crossing buffalos with cattle have been futile.

For beef.—Buffalo meat is poor in quality and has a strong, unpleasant taste. It is eaten only by the poorer classes and semi-civilized or savage tribes. The latter sometimes allow it to become putrid before consuming it.

For draft.—While of primary importance in the cultivation of rice lands, and, in the Philippines, in working the sugar plantations, the buffalo is used also as a draft animal for hauling merchandise and farm products, and its great strength is utilized in dragging heavy timber from the forests. Sometimes, although rarely, it is harnessed to vehicles to carry the traveler over unfrequented routes, an exceedingly slow means of conveyance but acceptable at times, and quite in keeping with the customs of the country.

For hides and horns.—The hides and horns of the water-buffalo are valuable in commerce. The leather is comparatively light, durable and impervious to water. Besides supplying the local demands, large quantities are annually exported from Manila, mostly to the Chinese and Indian markets.

For hunting.—Bulls of the larger breeds are used in India in hunting tigers, for which animals they have no fear and will even attack and kill them in single combat. In the marshes, buffalos are employed by sportsmen hunting water-fowls and other game-birds.

Price of buffalos.

The price of buffalos varies, like that of other stock, with the age and usefulness of the animal and with the demand. The prices paid under contract for working animals by the civil government of the Philippines, in importations from China, ranged from $40 to $79, Shanghai currency, the greater number being purchased at the latter price. In Assam, the average price for males is Rs. 45; for especially fine animals, Rs. 80. The value of cows depends on their age and milking qualities, full-grown animals in breeding condition ranging from Rs. 70 to Rs. 100; unusually excellent milkers bring a much higher price. In Bombay, cows are sold at Rs. 10 per ser (2 lbs.) of milk given per day. Wallace cites an instance of a cow that gave 24 ser daily. In Italy they are valued at 600 to 900 francs; in Hungary, at $50 to $100. [A rupee (Rs) is about 45 cents; a franc about 20 cents.]

Diseases.

The diseases of buffalos are the same as those that attack cattle; the symptoms are identical and the diseases are subject to the same treatment. Very rarely is any treatment or remedy applied by the natives or any attempt made on their part to separate diseased from healthy animals.

According to the Philippine census, there were 1,172,223 buffalos in the islands in 1902, valued at 49,319,755 pesos (a peso is about 50 cents). In the same year the loss from disease, chiefly rinderpest, amounted to over 42 per cent of the entire number; in some localities the mortality ran as high as 70 per cent. A part of this loss is attributed to hemorrhagic septicemia (see page 132), surra (see page 140) and foot-and-mouth disease (see page 143). The cause of hemorrhagic septicemia is obscure; surra, in some instances at least, follows the use of virulent blood containing the organisms of this disease in inoculations against rinderpest; foot-and-mouth disease is common in Manila and other ports, where shipments are made by steamers and where the animals are kept in corrals or much used in the streets and roads. It is not serious except in complication with rinderpest.

The mortality among the buffalos imported into the Philippines from China in 1903–04 was 47.6 per cent; in the case of one shipment it amounted to 100 per cent. These animals were regarded as healthy or free from disease when accepted, and the great mortality that almost immediately followed their importation has never been clearly accounted for. It may have been due, in part at least, to the inexperience of those in charge, the use of defective serum and the incautious use of virulent blood in the simultaneous inoculations. The whole endeavor to aid the Filipinos by these importations was experimental, and proved to be a very costly experience.

The use of anti-rinderpest serum, hypodermically injected in proper quantity, has been found effective in the treatment of the disease in the Philippines, affording immunity for a period varying from one to two months. Permanent immunity, it is said, is secured by the simultaneous method of inoculation, which consists in injecting into one side 1 cc. of virulent blood from a sick animal and 30 cc. of serum at the same time on the other side. Animals already diseased have been cured by injecting anti-rinderpest serum directly into the jugular vein. The simultaneous method of treatment can not be employed when other diseases, especially surra, or hemorrhagic septicemia, exist as complications. The Director of the Insular Bureau of Agriculture states (Report for 1906, p. 177) that under the conditions which prevail in these islands the serum method promises the best results for general use. The simultaneous method may be used to advantage where the country is densely settled and the animals assembled in large numbers, provided no complicating diseases prevail at the time of inoculation. The deferred method,—inoculation with virulent blood followed in about ten days with serum,—is practicable only with small herds of valuable animals, and when complications might follow the simultaneous method.

In India, inoculation has been proposed as a general panacea for all cattle diseases, but in general application it has proved disappointing. In cases in which the animals can be carefully nursed during the fever resulting from the operation, it might prove perfectly successful. One of the great difficulties that stand in the way of its introduction on a large scale is the fact that often two or three separate and distinct diseases have to be guarded against.

Other diseases that affect the buffalo are guti, kachua, marki, haiza (cholera) and matikhowa (earth-eating). These are local Indian or Hindu names.

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CAMELS IN NORTH AMERICA. *Camelus*, spp. *Camelidæ.* Figs. 8, 9.

By *G. A. Mack.*

According to a writer in the International Encyclopedia, North America was the original home of the Camelidæ. The oldest form (Prototylops), hardly larger than a jack-rabbit, yet camel-like in many particulars, is found in the upper Eocene rocks. A steady increase of size goes through the ascending formations of the Miocene, until we reach Procamelus, found in the Loup Fork beds of Wyoming, which was as big as a sheep and very llama-like. During the Miocene, the western American plateau seems to have been an arid desert, and under such conditions were developed the large, splayed feet, bereft of the useless side toes, the great sole-pads, and the pouched stomach that characterize the race. At the close of the Miocene, however, there came about a steady change toward a warmer, moister climate, inducing forest growth, which put an end to camel life in North America. Meanwhile they had migrated into South America, where fossil remains of great size are found, and where the family still survives, in the modified and perhaps degenerated forms of the llamas (Fig. 11); and northwestward to Siberia, thence into Central Asia, where their remains are found in the Pliocene

rocks of India, but not earlier. There the conditions were favorable, and the modern camels seem to have developed.

The genus Camelus is composed of two species, the true or Arabian camel (*Camelus dromedarius*), having one hump, and the Bactrian camel (*Camelus bactrianus*), having two humps. These humps are stores of flesh and fat, and may be entirely absorbed in case of famine. After a long journey with little or no food, they are noticeably smaller, and may even disappear.

Importation of camels to America.

Efforts have been made to introduce camels into America for transportation purposes. It is recorded that camels were taken to Peru shortly before the beginning of the seventeenth century, and also that a few reached Jamaica and Virginia, but without great success. In *ante-bellum* days, supplies for the military posts in western Texas, New Mexico, and Arizona were shipped to Indianola, Texas. Thence they were conveyed by trains of wagons, drawn by oxen or mules, to points in the interior. Much of the territory traversed was a desolate waste, and stretches of forty to ninety miles between watering-places were frequent. The trails were marked by the bones of countless animals that had died of thirst, and even human lives were sacrificed to the necessity of relieving, as promptly as possible, the wants of some lonely garrison in the wilderness.

So slow, dangerous and costly was the method of transportation then in use, that the War Department looked about for a better way, and finally suggested to Congress the importation of camels to serve as burden-bearers in the arid Southwest. Just who conceived the idea is not positively known. The credit is given to Major G. H. Crosman and Major Henry C. Wayne, two military commanders. Jefferson Davis, then in the Senate and afterward Secretary of War, took great interest in the matter, and worked for its accomplishment. Many others interested themselves in the question and an effort was made in the winter of 1852–53 to authorize the Secretary of War to make an importation of camels and dromedaries. But it was not until two years later that the department was authorized and directed to attempt the experiment by the following resolution, approved March 3, 1855: "Thirty-third Congress, Second Session, Chapter 169, Section 4. *And be it further enacted,* That the sum of $30,000 be, and the same is hereby, appropriated, to be expended under the direction of the War Department in the purchase of camels and importation of dromedaries, to be employed for military purposes."

February 2, 1857, Congress, by resolution, called on the Secretary for information "showing the results of the trial of the camel as a beast of burden and for the transportation of troops." Following is an excerpt from Mr. Davis' report: "Under the appropriation of $30,000, seventy-five camels have been imported. The aid furnished by the Secretary of the Navy in the use of a store-ship returning from the Mediterranean greatly reduced the cost of transportation, enabled the department to introduce a much greater number of camels than was originally calculated, and has secured to the government the means of making the experiment on a scale which will sufficiently demonstrate the adaptation of the animal to the climate and circumstances of our country and its value for military purposes. The limited trial which has been made has fully realized my expectations and has increased my confidence in the success of the experiment."

From the mass of correspondence accompanying the report, it is learned that Major Henry C. Wayne was detailed to buy the camels. He went first to England, and while there saw Prof. Richard Owen, who assured him that there would be no difficulty in acclimating and breeding the camel in the United States. Wayne also visited the Zoölogical Garden to study the feeding, care and hygiene of the camels and dromedaries in that institution. Further investigations were made in France and the Crimea. In six months spent in Egypt and neighboring countries, he secured thirty-three camels, including two fine specimens presented to him by Bey Mohammed Pasha. There were seven males in the consignment. The average price paid was about $250 per camel. Six Arabs and a Turk were employed to attend the camels on the ship.

Embarking with his charges February 11, 1856, he arrived at Indianola, May 14. The animals were in good condition, considering their long confinement on shipboard, and were, with the exception of a few boils and swelled legs, apparently in health. Major Wayne eventually became enthusiastic, and requested permission to hire a breeding farm for his charges. The department replied that the establishment of a breeding farm did not enter into its plans, its object being merely to ascertain whether the animal was adapted to military service and could be economically and usefully employed therein.

In June, 1856, Lieutenant D. D. Porter was sent after another load of camels. On December 13, he wrote that he expected to be at New Orleans with the store-ship Supply and a cargo of forty-four camels some time in January. It was not, however, until February 10, 1857, that forty-one camels (three having died) were landed at Indianola from the steamer Suwanee. Lieutenant Porter has this to say regarding the animals, as he observed them in North Africa: "In their campaigns against Algiers, the French were surprised to see their camels, although reduced to skeletons, making forced marches with their loads. Mules in their condition could not even have carried their saddles. A camel's flesh is as good as beef. You can hardly tell one meat from the other. Camel's milk is very good, as I can testify, because I used it in my coffee."

The camels seem to have been used with greater or less success for the next few years. Late in 1857, Lieutenant E. F. Beale employed camels in a survey to open up a wagon road from Fort Defiance, New Mexico, to the eastern frontiers of California. The journey occupied forty-eight days. Lieutenant Beale praises highly the service rendered by the camels on this occasion. John B. Floyd, then Secretary of War, made repeated efforts to induce Congress to make another appropriation to

continue the experiment on a larger scale, but to no avail. Following this, many of the camels were held at the various military posts in California, where they received scant attention. On September 9, 1863, the War Department ordered the camels in California to be sold at public auction. It is thought that many of these animals eventually found their way into circuses, menageries and zoölogical gardens, and others were abandoned. Some of the remainder of the camels were still at Camp Verde, the camel station, at the close of the Civil war. These were likewise disposed of at public auction, and some of them were driven into Mexico.

About 1861, a San Francisco company imported twenty Bactrian camels from Central Asia, more than half of which were employed in Nevada in carrying salt. It is supposed that these were afterward taken to Arizona.

Having reached this point, the student of camel history steps from the solid ground of official record to flounder amid the fantasies of the newspaper paragrapher, supported only by the recollections of the oldest inhabitant. Search as one may, no further word can be found in Government archives concerning this experiment in transportation, nor of the subsequent history of the poor animals abandoned to their fate in a strange country. That they were so abandoned, there is indubitable evidence, though it may well be doubted that they were turned loose in obedience to a formal order. The remaining unsold camels, not having proved so useful as was anticipated, were scattered in small bands among the different posts. Tired of caring for the animals, and receiving no further instructions regarding them, it is likely that the commandants of the posts where they chanced to be, turned them out, expecting them to feed and remain in the vicinity, where they could be recaptured when wanted. They evidently did not know that the camel is the most losable animal ever domesticated. The liberated beasts, with one accord, whether intending to take ship at Indianola, or to foot it back to Egypt, headed southeast. Ultimately they reached the Texan coast. If any of the animals remained in New Mexico or Arizona, persistent epistolary persecution of postmasters, and others in those parts, has failed to produce testimony to that effect.

Regarding the camels that drifted to the coast, much information is obtainable. Captain Thomas Field, of Victoria, Texas, supplies many interesting details, some of which appear to fill in apparent gaps in the official record. In 1857, Captain Field, then twelve years old, began a long-continued acquaintance with the camels. Some time in that year, he and other boys in that vicinity followed for miles a caravan of camels that passed through Victoria. The animals, which he says had been kept for months at Indianola to recuperate from the effects of their ocean voyage, were on their way to El Paso, in charge of Arab attendants and a troop of soldiers. Captain Field thinks there were more than one hundred camels in the train. That, of course, is a too liberal view of the matter. It is possible that the drove brought over by Major Wayne was held at Indianola until the arrival of the lot imported by Lieutenant Porter. If that was the case, the Captain saw seventy-four adult camels. He says there were camel colts — or is it calves?—with the caravan; but surely there could not have been enough of them to bring the total number to 100. After having remained near Victoria a day or so to refit and readjust saddles and packs, the procession set out for San Antonio. So far everything was satisfactory, the first report to Washington was favorable, and the problem of transportation seemed to have been solved. At San Antonio soldiers and citizens turned out to welcome the exiles from Egypt.

When the line of march was taken up for El Paso, the rough rock-road began to tell on the camels. It was soon found that the pads of their feet were wearing to the quick, while in some cases stone-bruises appeared. The problem of shoeing a divided foot without a hoof on it proved unsolvable. Blacksmiths made half shoes, hinged shoes and solid shoes, but in the absence of hoofs to which to nail them, no way to retain them in place could be devised. Then the butcher was applied to for a supply of rawhide, and the feet of the camels were wrapped in that material. The rawhide shoes served the purpose, but wore out about as fast as they could be made.

At the outbreak of the war, Captain Field joined the Fourth Texas cavalry, and saw service in New Mexico. There, at different forts, he came across small bands of camels, "laid up for repairs." When he returned, in 1865, to his home near the mouth of the San Antonio river, in Refugio county, he found his cameline friends had preceded him. As the camels worked southward, most of them struck into the country between the San Antonio and Guadaloupe rivers. Being unable to cross either and apparently unwilling to turn north again, they found themselves stopped at length by the junction of the two rivers. That is in the vicinity of Hines bay, and thereabouts the beasts remained. A few that turned south farther west than the main bunch were stopped by the Guadaloupe at Camp Verde, 200 miles higher up. Although the camels around Hines bay proved a decided nuisance to the settlers, no attempt was made to capture them, nor were they molested in any way. The opinion prevailed at that time that government property was best let alone. Some time in 1868, however, a traveling showman named Robertson passed through the county, and, learning of the presence of the camels, and the desire of the neighborhood to be rid of them, rounded up eleven head and took them away. What he did with them is not known.

Enjoying perfect liberty in an almost semi-tropical country, it seems strange that the herd should not have increased instead of retrograding. Captain Field saw a two-year-old in 1866. Being notedly long-lived beasts, it seems impossible that all could have died of old age within ten years. Despite the general good treatment which, the captain says, the animals received, it is probable that the taste of camel steak was not altogether unknown in that region. No one attempted to make any practical use of the roaming animals.

Literature.

Charles C. Carroll, The Government's Importation of Camels, Circular No. 53, Bureau of Animal Industry, United States Department of Agriculture; G. A. Mack, An Experiment in Transportation, Shield's Magazine, May, 1906. This article is adapted from these two sources. Wortman, Bulletin, American Museum Natural History, X, New York, 1898, contains notes on the American fossil camels.

CAT. *Felis domesticus. Felidæ.* Figs. 329, 330.

The domestic cat has played its part in the advancement of agriculture, as in the pioneer days it made living possible in the new country, with its innumerable host of rodents, especially mice, which otherwise would have riddled the pioneer's store of provisions. And today it is found on the farm, sharing with the dog the police duty of the buildings and grounds, as well as satisfying a natural desire for animal companionship.

The cat may be a nuisance, however, unless carefully managed and controlled. Being allowed free access to the sick and the well, and being herself subject to germ diseases, she may be a carrier of contagion. On the Pacific coast she breeds countless fleas. It is as a destroyer of birds, however, that the cat is a most serious menace to agriculture. At a time when we are trying to spread a love of birds and of nature, we should see to it that, in protecting birds, the children are not merely rearing more feed for cats. Bells on cats may prevent their catching mature birds, but they do not hinder them from robbing nests or taking young birds; they are, therefore, not of much use until after the fledgling season is over. Of all domestic animals, the cat is the only one that is allowed to roam at will without being regarded as a trespasser or nuisance. All cats should be confined to the buildings of the owner; or, if not controllable, they should be limited by cages (or wire-screen rooms) or allowed to run from a wire to which they are secured by a collar and cord. Herein lies the solution of the problem,—the treating of all roaming cats as wild animals and trespassers. It is just as much one's duty to keep his cats at home as to keep his horses, dogs and chickens at home. Mice and rats should be destroyed by constant use of traps. Many of the birds are protected by law, and yet persons who think that they respect the law may allow their cats to roam at will. It may be true that some birds are themselves a menace to agriculture, but cats do not discriminate; the fundamental point is that cats, as well as other live-stock, should be controlled.

Cats and their care.

By *E. R. B. Champion.*

The many varieties of cats known today are founded on but two types, the long-haired cat of the East and the short-haired cat of Europe. Show cats of both groups are judged by practically the same standard as to color and conformation. In both types the *head* should be as large as possible, round in shape, with large, full eyes, small ears set far apart on the skull, and a short, wide nose. The ears and feet in the long-haired species should be well feathered or "tufted" with long hair, as this is a sign of high breeding. The *body* should be short and compact, the tail short and tapering and carried low; but it should be of such length that it does not touch the ground when the cat is in motion. The *legs* should be thick and short. The only cats that differ in appearance from the above standard are the Manx, Siamese and Abyssinian. These varieties are very rare in this country. The *coat* of a long-haired cat is soft and silky, hanging in wavy masses, whilst that of the short-haired cat is harsh, short and has an even glossy appearance. The *color of the eyes* differs with each variety; for example, a white cat should have blue or orange eyes; a blue cat, either long- or short-haired, should have orange eyes, as should also a black, tabby, smoke, cream, orange, or tortoiseshell; the chinchilla and shaded silver should have eyes of a deep blue-green, sometimes called "*eau de nil.*"

Breeds and types.

As has been said, cats are commonly divided into two groups or types, the long-haired and the short-haired. Within these groups, color and conformation, more especially the former, are the marks of distinction, and the varieties are bred for these features. We have chiefly the self-colored and the tabby types. A self-colored cat is of one uniform shade or solid color, as black, white, orange and blue. The varieties of tabby and the combinations of color are several—blue, orange, brown, silver (Fig. 329), gray and tortoiseshell.

Fig. 329. A prize-winning, long-haired silver tabby. Lady Vere de Vere, winner of eighteen prizes in England and America.

Long-haired cats have long been known in India, France, China and Persia. Formerly the several varieties were more or less distinct and were sub-divided into Angora, Persian and other classes. These varieties have been so interbred for years that it has been considered advisable to designate them all as "long-haired cats," as it would be impossible to distinguish any one characteristic breed in the present day.

Colors known solely to the long-haired cat are the *chinchilla, shaded silver,* and *self-orange.* The first named is the rarest of all, and it is very difficult to secure a fine specimen. The coat should be of a pale silver-gray, almost white at the roots. There should be no tabby markings, and it is this elimination of stripes that makes it such a task to

breed a fine specimen. The shaded silver should be silver evenly tipped with dark shadings on face, back and legs. It is a very handsome cat. Like the chinchilla, it should have green eyes and be free from tabby markings. The self-orange, as its name implies, is of one uniform shade of orange, free from tabby marking, and with deep orange eyes.

Tabbies should have a pure ground color with broad, black markings ; for example, a brown tabby is practically sable or tawny colored, marked with dense black stripes. The orange tabby is marked with a deeper shade of orange instead of black, and in this particular differs from other tabbies. It has been the standard for many years that all tabbies should have deep, orange-colored eyes, but there is now a movement among breeders to introduce green or emerald eyes for the silver tabby.

The cream-colored cat is very rare in the short-haired varieties, although there are many long-haired specimens. The color should be clear biscuit or fawn, and the eyes orange-colored.

The smoke cat, known to both long-haired and short-haired varieties, is, in the latter, an apparently black cat, but the fur at the roots is pale, clear silver. In the long-haired variety, the silver undercolor breaks through, forming a pale silver ruff around the face, and pale silver fur on the underside of the body and tail ; no trace of tabby marking is allowable.

The tortoiseshell cat, both a long- and a short-haired type, is of three distinct colors, red, yellow and black, evenly distributed over the body, face, legs and tail in patches. No ticking or tabby marking is desirable. Curiously enough, cats of this color are always females.

The Siamese cat is a distinct variety of short-haired cat, peculiar to Siam, as its name denotes, where it is highly prized, and propagated under Royal supervision. The color of a "Royal Siamese," as it is termed, is a clear fawn or dun, with extremeties—viz, nose, ears and feet—of deep chocolate or even black. The tail is shorter than in the ordinary short-haired cat and should be shaded with the dark chocolate color. The coat is particularly short, close, and of an even velvety texture, and the eyes should be an intense blue. Some authorities contend that the Siamese should have a "kinked" tail, but many persons consider this eccentricity due to the inbreeding which undoubtedly exists among these cats in Siam. Inbreeding, if practiced to a very great extent, will produce many deformities, and seems especially to affect the spine. The Siamese is the hardest variety of cat to raise; it seems very susceptible to cold and damp, and also to a form of brain trouble. The shape of the head, both in Siamese and in Abyssinian cats, differs from other varieties, being more like that of the original wild cat, that is, wedge-shaped.

The Abyssinian cat resembles in its coloring the Belgian hare rabbit. The fur is of a rufus-red color, ticked evenly with black, with a black stripe down the spine, continuing to the extremity of the tail. This cat resembles in size the domestic or short-haired cat. The coat should be close and soft, and the brighter in color the better. The writer has never seen specimens of this variety in America, but they are bred in England, where there is a "Specialty Club" to encourage their propagation.

The Manx cat (Fig. 330) is native to the Isle of Man. It is noticeable primarily for its absence of caudal appendage, and for the length of the lower joints of its hind legs, which gives it, when in motion, somewhat the action of a rabbit. These

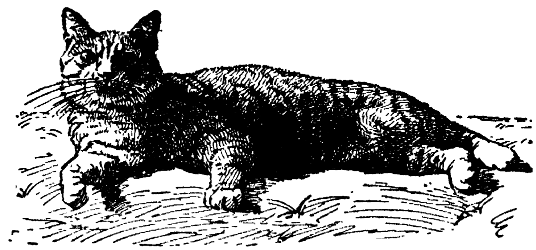

Fig. 330. A Manx cat.

cats are very rare in this country. For exhibition purposes they should show no trace of tail and should also have the characteristic action of the true Manx cat. In colors they correspond with the varieties known as short-haired domestic cats.

Breeding.

In breeding cats, it should be remembered that they are carnivorous animals, and therefore it is not advisable to start breeding on such an extensive scale that it is impossible to feed them in a natural way. Breeders should limit their operations to raising a few certain colors. Cats are prolific breeders, and, if allowed to do so, will raise three to four families in one year. If they are desired for exhibition, however, only one litter a year should be attempted, as much finer specimens will thus be secured and they will be less likely to contract diseases.

Breeding cats should be chosen for their pedigree and conformation. To attain the best results, one should not cross different colors or varieties, but breed blue to blue, black to black, and so on. In striving to secure a type of cat as near perfection as possible, a certain amount of inbreeding is necessary. This is true in breeding all animals, and although show specimens can be, and are secured without it, it will be found that the good points of parents will not be reproduced in the offspring unless inbreeding is resorted to in order to fix the type.

If one is breeding self-colors, as black, white, or blue, special attention must be paid to the soundness of the color ; whites must be free from creaminess ; blacks must be coal-black, with no white hairs and no shading of the color toward the roots of the fur ; the blue cat should be a uniform shade of blue throughout.

In breeding tabbies, either long-haired or short-haired, the principal point is distinctness and depth of markings, with purity of ground color. As the best known variety of tabby is the brown, this will serve to illustrate what we mean. In this variety, the ground color must be as clear a sable

or tawny color as possible, not ticked with black, and the markings, to be perfect, must be a deep, dense black, not ticked with the brown of the ground color. The tabby markings should correspond on both sides of the cat, and should form distinct lines or necklaces about the throat and chest. The tail also must be tabbied.

Feeding and care.

In raising cats, meat should be the staple diet. This may be mixed with green vegetables, but farinaceous and starchy foods, such as rice, oatmeal and potatoes, should be strictly avoided; water should be given to drink, and no milk. The latter is peculiarly indigestible to cats.

Cats should be kept excessively clean, both as to the freedom of their coats from all vermin, and also in regard to their quarters. They are naturally very clean in their habits. If properly treated, they are gentle and docile in disposition.

Diseases.

Cats are very susceptible to dampness. While they will flourish in a dry, clear, cold, and require no heat in such a climate, dampness will bring on many ills, such as pneumonia, opthalmia and distemper. The principal causes of mortality in kittens are indigestion and distemper. By strict attention to cleanliness and diet, the former may be avoided to a great extent. The latter, an infectious disease, is frequently contracted through undue exposure, or more commonly from infected cats. The principal remedies for indigestion are sub-nitrate of bismuth and pepsin. For distemper, there is no known cure. It is a disease rarely contracted by animals over one year old. The best treatment is warmth, nourishment and tonic. Quinine in very small doses is beneficial. The most common remedies used in opthalmia are boracic acid and sulfate of zinc lotions, and the oxids of mercury, both yellow and red, in very severe cases. In giving medicine and applying external lotions to cats, it is well to remember that preparations of carbolic acid or coal-tar are peculiarly poisonous to cats, as is also any preparation of opium.

Organizations and records.

Some of the principal organizations for improving the condition of the cat in this country are, The Beresford Cat Club, of Chicago, The Atlantic Cat Club, The Lockehaven Cat Club, The Short-haired Cat Society, The Buffalo Cat Club and The Washington Cat Club, among many others. There are also two associations of breeders formed for the purpose of maintaining proper registration of pedigrees, making show rules and regulations and similar work. These are the American Cat Association, with headquarters in Chicago, and the Cat Fanciers' Association, with its secretary in Buffalo. There are many foreign organizations, notably in Great Britain.

The first registry of cats to be founded in America was the Beresford Cat Club Studbook in Chicago. In Great Britain there are the National and the Cat Club studbooks (the latter now discontinued).

Literature.

Much has been written about cats. The following references will suggest other sources of information: John Jennings, Domestic and Fancy Cats; Frances Simpson, The Book of the Cat; G. Stables, Cats: Handbook to Their Classification, Diseases and Training; H. Weir, Our Cats, Varieties, Habits and Management.

CATTLE. *Bos taurus*, Linn. and *B. Indicus*, Linn. *Bovidæ*. Figs. 331–394; also Figs. 14–16, 35–38, 45–49, 131, 132, 276; also Fig. 1.

Cattle are the most important domestic animals of the English-speaking peoples. They are beasts of labor, and they afford meat, hides, and milk; and from the milk are made cheese and butter and many products of lesser importance. Cattle are animals for poor and rich alike. With a very few acres of land, a few fowls and a cow, a family cannot starve. In great herds of many highly developed and elaborately recorded breeds, cattle afford entertainment for the wealthy. In all regions of men between these two extremes, cattle are sources of subsistence and satisfaction.

Cattle have responded remarkably to the needs of man by varying under his care, and developing into many forms. There are no cattle so dwarf as are the smallest ponies among horses, although the Kerry is very small, but diminutive races would undoubtedly have developed if there had been any utility in preserving them; yet there are great ranges of size and shape and temperament. Color ranges from clean white to jet-black, through roans, grays, bays, and various grades of brown-reds, and with many brindled and parti-colored kinds. The first great development of cattle was for labor. With the increasing use of the horse and of machinery, this utility of cattle has fallen away. Perhaps fashion and the mere desire to move quickly have had something to do with this disuse; it is probable that work oxen can be economically used at the present time in American agriculture to a greater extent than they are now employed. The second great evolution of domestic cattle was into breeds that are specially adapted for the producing of beef. The third stage is the special development of the dairy cow, coincident with the growth of cities, and the demand for more of the amenities of living. There has arisen a strong divergence in form of body and in constitution between the beef type and the dairy type. This divergence has emphasized the departure from the older unpedigreed cattle, so much so that we now often speak of animals that are profitable in production of both beef and milk as "dual-purpose cattle."

With the development of understanding of the physiological laws of feeding, cattle-farming has taken on a new significance and impetus. New interests have centered about it. To this interest is now to be added a rational practice in stable construction and in general care, and a new realization of what is meant by cleanliness. Breeding is taking new direction. In the meantime, the

general agricultural economy has undergone great change, calling for new adaptations in the cattle.

According to the Yearbook for 1906, United States Department of Agriculture, the number of cattle in America was as follows:

	Year	Total	Dairy cows
UNITED STATES:			
Contiguous—			
On farms . . .	1907	72,534,000	20,968,000
Not on farms . .	1900	1,616,422	973,033
Noncontiguous:			
Alaska (on farms)	1900	18	13
Hawaii (on farms)	1900	102,908	4,028
Porto Rico . . .	1899	260,225	73,372
Total United States (except Philippine Is.) .		74,513,573	22,018,446
CANADA:			
New Brunswick . .	1905	230,000	111,084
Ontario	1906	2,963,618	1,129,047
Manitoba	1906	521,112	170,143
Saskatchewan . . .	1906	472,854	112,618
Alberta	1906	950,632	101,245
Other	1901	2,123,932	1,033,295
Total Canada		7,262,148	2,657,432

The same Yearbook gives the number and value of milch cows and other cattle in the United States:

	Milch cows		Farm value	Other cattle		Farm value
	Number	Price per head		Number	Price per head	
January 1, 1867	8,348,773	$28 74	$239,946,612	11,730,952	$15 79	$185,253,850
January 1, 1907	20,968,265	31 00	645,496,980	51,565,731	17 10	881,557,398

The Canada Yearbook for 1905 gives the value of milch cows in Canada in 1901 as $69,237,-970, and of other horned cattle, $54,197,341. The number of milch cows in Canada in 1871 is given as 1,251,209, and in 1901 as 2,408,677; the number of other horned cattle in 1871 is given as 1,373,081, and in 1901 as 3,167,774.

Literature.

The literature on the types and breeds of cattle is scant, and for the most part is combined with discussions of the other common farm stock. There are few monographs. Plumb, Types and Breeds of Farm Animals, Ginn & Co. (1906); Shaw, The Study of Breeds, Orange Judd Co. (1905); Wallace, Farm Live-stock of Great Britain, Orange Judd Co. (1908); Allen, American Cattle, New York (1890); Flint, Milch Cows and Dairy Farming, Boston (1889); Housman, Cattle: Breeds and Management, London (1897); Consular Report, Cattle and Dairy Farming, Washington (1887); Youatt, Cattle: Their Breeds, Management and Diseases, London (1835); Brooks, Agriculture, Vol. III; Craig, Judging Live-stock; Sanders, Breeds of Live-stock. See special references given under the several breeds.

INDEX TO CATTLE ARTICLES

Origin of Domestic Cattle.

By *Frederick B. Mumford.*

Domestic cattle have been derived from at least three distinct prehistoric species, *Bos primigenius*, *B. longifrons*, and *B. frontosus*. The first, *B. primigenius*, also called Urus, was the species domesticated by the Swiss lake-dwellers, and existed in considerable numbers down to historic times in the forests of Europe. Cæsar mentions this animal as having been seen in large numbers in the Hercynian forest, and describes it as being little smaller than an elephant, but with the form and character of a bull.

The Friesland cattle of continental Europe and the Pembroke cattle of Wales are supposed to have descended from the Urus. Degenerate examples of this species exist at the present time in the parks of Great Britain, Cadzow forest and Chillingham park containing the purest specimens of these animals. They are white with reddish ears, and become fierce and dangerous when angered. The *B. longifrons*, or Celtic ox, formerly wild in Sweden, was also bred by the ancient lake-dwellers. It is smaller than our modern breeds. Owens regards this species as the original of the Welsh and Highland breeds of cattle, and later of the Shorthorn. *B. frontosus* was larger than *B. longifrons*, but existed with it in Scandinavia. The mountain cattle of Norway are supposed to have been derived from this species.

The domesticated cattle of the world are now thrown into two species: the *Bos taurus*, or common

Plate VIII. Types of beef cattle.—Hereford bull above, Aberdeen-Angus bull below

cattle of Europe and America, and the *B. Indicus*, the humped cattle of India, also called zebus. The humped zebus were domesticated in Egypt 2,000 years before the Christian era. They are distinguished from common cattle principally by an immense hump of fat over the shoulder and a loose and very large dewlap, drooping ears, short horns and thin, sloping hips and rumps. They are extensively employed as beasts of burden and are often used as saddle animals. They have an easy trot or gallop, with great powers of endurance, being able to cover sixty or seventy miles in a day The appearance of a male albino among the herds is hailed with great joy, and this animal becomes the sacred bull of India and plays a very important part in certain religious festivals. The zebus enjoy a dry, warm climate and avoid water. [The Zebus, also known as Brahmin or Sacred cattle, are discussed at length on pages 378, 379.]

The prevailing type of cattle common to Europe and America belongs to the species *B. taurus*. From this animal all the various races and breeds have descended. This form early reached a high degree of development in Europe, and from this center has been widely dispersed to every civilized country on the globe. The first attempts at selection were very crude, and little progress was made toward the present-day highly specialized forms. The systematic improvement of cattle by man began about the close of the eighteenth century. The greatest progress was made in Great Britain, and to Robert Bakewell (1725–1795), of Leicestershire, England, must be given the credit of producing such markedly superior animal types as justly to have entitled him to the distinction of being called the father of the science and art of modern cattle-breeding.

The domestic races of cattle which exhibit enough fixity of type to be called distinct breeds are very numerous. A general classification divides existing breeds into beef and dairy cattle. No sharp line of distinction exists between the two, although there is a wide difference between the extreme development of these two types. The most common special beef breeds in America are Shorthorn, Hereford, Aberdeen-Angus, Galloway, Sussex, Polled Durham and Polled Hereford. The extreme dairy types are represented by the Jersey, Holstein-Friesian, Ayrshire, Guernsey, Dutch Belted, French-Canadian and the Kerry. Several existing breeds are valued for both milk and beef, and are called dual-purpose cattle. The breeds belonging to this class are the Red Polled, Brown Swiss, Devon and some families among Shorthorns. At a recent meeting of the American Brown Swiss Cattle Breeders' Association, however, a resolution was unanimously adopted to breed the Brown Swiss only for the distinct dairy type. Miscellaneous other breeds are represented in America in small numbers. [Some of these lesser known breeds are discussed on pages 377–382.]

For further discussions of the zoölogical relations of cattle, see the standard zoölogies; Lydekker, Wild Oxen, Sheep and Goats; Robert Wallace, Farm Live-Stock of Great Britain.

Selection and Management of the Dairy Herd. Figs. 331-335.

By *J. M. Trueman.*

In selecting a dairy herd it is necessary to have clearly in mind the type that is best for the production of milk. It is not to be expected that the animal that possesses the ability to use food economically for the production of meat will also be able to use it economically in the production of milk. The giving of milk is a different function from the production of meat. Those animals that give large quantities of milk for the sustenance of their young are likely to become thin during the milking period. The production by a cow of thirty, forty, or fifty pounds of milk per day calls for the use of food-materials in such quantities as to make it necessary for all the energies of the body to be devoted to that one object. Furthermore, the ability to produce milk in large quantities at the expense of laying up body fat becomes so characteristic of the good cow that she remains comparatively thin, even when well-fed and not milking. It is true that individuals are found that are fairly large milkers, and yet show a beef type; these cows are rare, however, and it has not been proved that they are economical producers of both beef and milk.

The general-purpose cow. (Figs. 49, 385.)

Many breeders have tried to establish a breed of cows that would be fine milkers, and whose offspring would at the same time be valuable as feeders for the butcher. They have failed to produce a general-purpose or dual-purpose cow of much merit, and must continue to fail to the end of time, for the simple reason that a high development of either function must always be at the expense of the other. The cow that will use her food for the production of 8,000 pounds of milk per year will not transmit to her offspring the ability to produce a fine carcass of beef.

The dairy cow. (Figs. 331, 332.)

The cows that should be selected for a dairy herd are characterized by spareness of form, good heart and lung development, and large digestive apparatus. A spare form, accompanied by good appetite and vigorous health, indicates that the food is used for the production of milk. Lung and heart power are shown by depth and width of chest, and thickness through the girth. The ribs should be well sprung. The floor of the chest should be wide, without a coarse, heavy brisket as in beef cattle. The skin should be soft and pliable, indicating good circulation. Good appetite and great digestive powers are shown by a general vigorous appearance, large muzzle and large abdomen. In viewing the side of the cow, the rear half of the body should show deeper and heavier than the front. The back line and belly line should diverge from front to back, showing a large development of abdomen and udder. This divergence must not be secured by lack of depth in the front of the body, but by extra depth in the rear half.

The tendency to use food for the production of

milk, or the dairy temperament as it is called, is shown by lack of fullness and roundness in the muscles all over the body. The thigh is thin and in-curved. The shoulder is bony and the withers thin and wedge-shaped. The healthy cow should have a general appearance of vigor and alertness, and at the same time show a bony framework, not too prominent and not coarse. The best type is shown in Figs. 331, 332, in which is seen a strong, vigorous body, without any tendency to fleshiness. The reverse of this type is seen in Fig. 333, in which we have the tendency to lay on flesh, and the small udder that belongs to the beef type. [See pages 50, 310.]

The best dairy cows possess, besides the proper form, a typical disposition. They are quiet, docile, motherly cows, that are able to produce large quantities of milk for their offspring, and yet perfectly willing to give the milk to the milker instead of to the calf; cows that are not too timid and nervous, and yet of a fine quality and even temperament that appreciate good treatment and comfortable quarters.

The dairy bull. (Fig. 334.)

The bull is a very important part of the herd. It is not possible to say definitely from his appearance whether or not his get will have dairy merit. The best that can be done is to select for dairy form as closely as possible, and to pay close attention to the breeding and constitution. The bull should be a "pure-bred." He should have a recorded pedigree that shows the performance of his ancestors. A bull that has a good pedigree, and shows a vigorous, well-formed body without being beefy is the one to buy. The type is illustrated in Fig. 334. Here we have a fine, vigorous, alert, symmetrical animal, that shows no indications of heaviness or coarseness. It is not necessary to look for extreme fineness of bone, or slenderness of form in the bull, for it must be remembered that the male above all things should be strong and vigorous. On the other hand, undue coarseness of bone and heaviness of shoulder should be avoided.

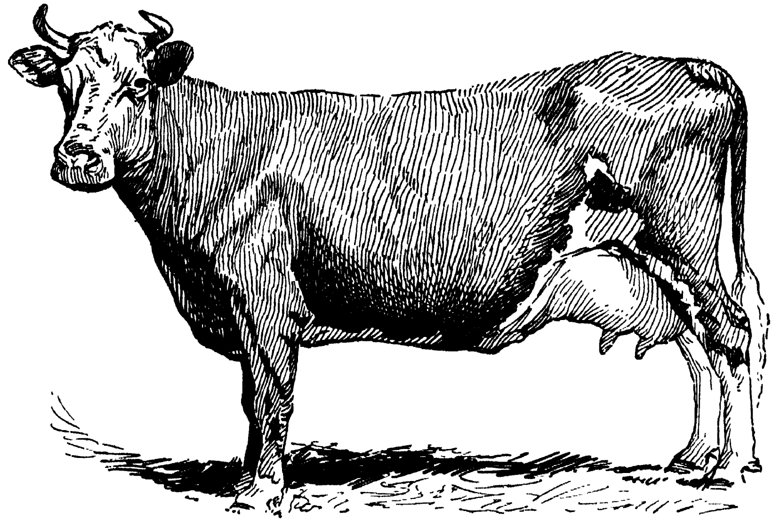

Fig. 331. Cow of dairy type. Rose.

The indiscriminate use of scrub bulls cannot be too severely condemned as a business proposition. It has been well established that careful breeding and selection of bulls gives them prepotency, or the ability to get uniformly a better class of calves than the scrub. This is just as true of the cow as of the bull. Pure blood may not be good blood in some cases. It may be weakened by bad breeding methods and careless selection. But good pure-bloods,—and these can always be secured,—are far superior to the average grades that are to be had, and very much better than most crosses. In selecting a dairy herd, get the best blood the available money will buy: in the bulls first, and then in cows. On this foundation, success may be expected.

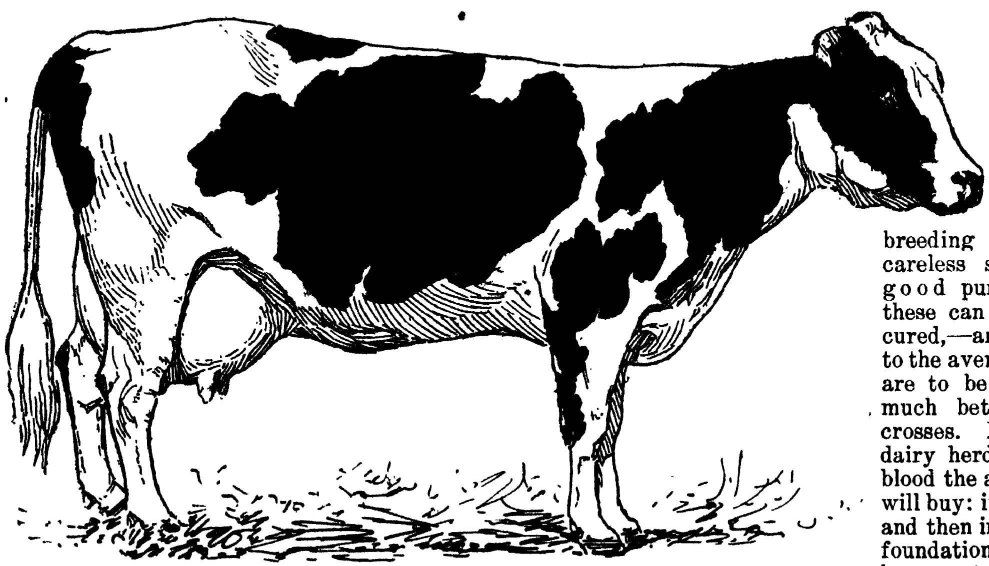

Fig. 332. Champion Holstein-Friesian cow, Colantha 4th's Johanna. Adv. R. No. 1849.

The dairy herd.

It is important to note that it is necessary to study individuals in selecting a dairy herd. No breed uniformly possesses dairy merit. Some breeds possesses it in greater numbers than others, but the ability to use food economically for the production of milk is an individual characteristic and not a breed trait. Cows possessing this dairy temperament may be found in all breeds, but cannot be found invariably in all the individuals of any one breed. Of course they are found in largest numbers in the dairy breeds; so much so that it would be folly to attempt to select a dairy herd from anything except a dairy breed. The particular breed to select from will depend entirely on the preference of the dairyman, and the conditions in which he is placed. It will generally be better to confine attention to one breed in each herd, rather than to mix several breeds. In many cases, by adhering to one breed, a working dairy may be bred up to such an extent as to make the sale of high-bred grades or of pure-blood animals more profitable than the production of milk. Under proper management these two products may well be developed together, and enhance greatly the money-making power of the herd. It may be well, however, to emphasize "proper management," as the average dairyman will find it a difficult matter to handle the production and sale of high-priced stock successfully.

From the foregoing it will be surmised that the best way to get a good daiiy herd is to breed one. Such a conclusion is undoubtedly correct. It is not easy to find animals of the right quality on the market. If found at all, they must be picked up here and there at high prices. In general, then, it is best to breed up a herd rather than to try to keep it up by buying. Having decided to follow this method, the best start possible should be made. The cows to start with should be of the best type and performance to be had, and should be bred to the best pure-bred bull that the available money will buy. If the record of the cow's performance is at hand, it should show a yearly production of at least 6,000 pounds of milk, and 250 pounds of butter-fat. That is not a high record, but is fair to start with. If 8,000-pound cows can be had with 300 pounds of butter-fat, so much the better. Do not use a cow that will not produce more than 4,000 pounds of 3.5 per cent milk in a year. Four thousand pounds would not be so bad if it tested 6 per cent of butter-fat, thus giving 240 pounds of fat.

The care of young stock.

Having selected the foundation of a herd, the next important point is the selection of the calves that are to be reared. This is not an easy proposition. The best we can do is to raise the well-developed heifer-calves from the best cows. Only those that are plainly deficient need be killed at birth. The majority of the heifers will be healthy and vigorous, and can be given a trial. Most of the bull-calves should be killed at once or sold to men who will fatten them for veal. It will seldom pay the dairyman to use six weeks' milk to fatten a dairy calf for veal.

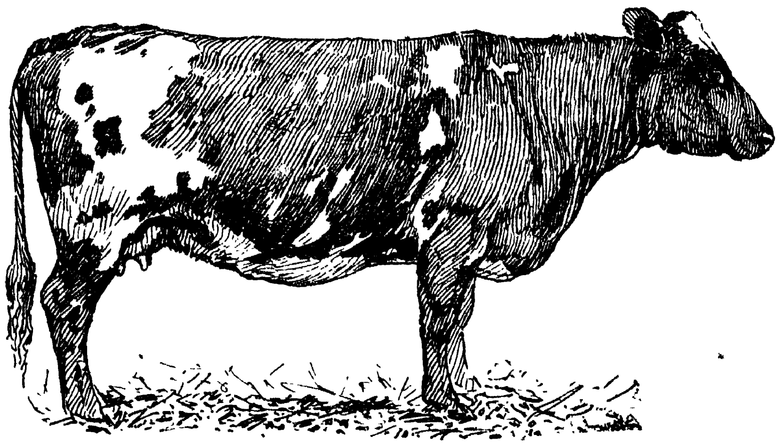

Fig. 333. Cow not of the dairy type.

The heifers should be fed on skimmed milk and quickly taught to eat meal and hay or grass. The feeding of whole milk is not necessary for any length of time. What is wanted is a growing healthy animal with a good appetite, and not a pampered fatling.

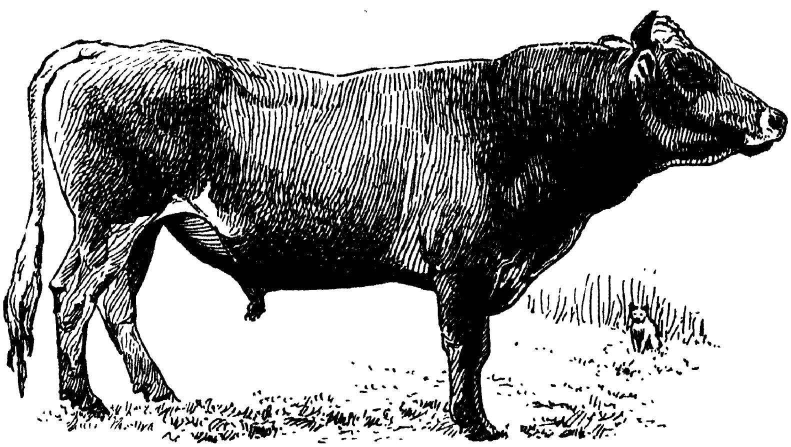

Fig. 334. Two-year-old Jersey bull.

The heifers should be bred at about twenty-one

months old, so that the first calves will be dropped at two and one-half years. This breeding-age may be varied somewhat, according to the development of the animal. If large and strong, breeding at eighteen months will do no harm; if backward, it had better be put off till two years old.

The first period of lactation will give a fair idea of the capabilities of the young cow. It is at the end of this first period that vigorous weeding out should take place. Every heifer that has failed to show good milking qualities, and a strong tendency to turn feed into milk, and to continue it until within at least six weeks or two months of the next calving time, should be discarded.

A heifer would be called promising if she produced 200 to 250 pounds of butter-fat within a year after dropping her first calf. A heifer falling below 200 pounds of fat would be regarded with suspicion, and should be discarded, unless there were some special reason for giving her another trial. This is the best time to turn the poor heifers into beef, and that is their only destiny. If not good dairy performers, they are likely to be in fair flesh, and as they are young and tender the butcher will pay more for them now than at any other time. They will generally bring a price that will pay the cost of raising them, and sometimes a little more. If they are kept for several years, however, they are constantly adding to their cost and becoming poorer beef. A more rigid weeding out should take place again at the end of the second period of lactation. Those heifers that were given a second trial should be dropped, unless they have materially improved on the first year's record. It is a poor practice to keep any cow that is not doing well. Every animal in the dairy herd should be an economical producer.

The length of the milking period has a great deal to do with the amount of milk produced in a year. It is important that the heifer shall milk persistently. This habit may be encouraged in the young cow by delaying her second pregnancy. Do not breed the second time until at least six months after dropping the first calf. This leaves her free to devote her energies to the production of milk. It must be remembered that the heifer is still growing, and needs to develop a vigorous body. The first pregnancy and the lactation period following tend to establish the milking habit, or, in other words, to develop dairy temperament. The giving of milk, well started, may be continued for some months without subjecting the young cow to the strain of raising two calves within a short period. If she does not respond to this management, but "goes dry" in six or eight months, she had better be turned over to the butcher at once.

The time of year at which the calves shall be dropped is worth considering. The prices of dairy products are invariably much higher in the fall and early winter than in the spring and early summer. For this reason, it is good business policy to have a large flow of milk in the fall. This is accomplished by having a majority of the cows freshen in the fall; local conditions will determine just how many. One of the great advantages of dairying as a business is the fact that the income is continuous. There is no waiting until the crop is planted, tilled and harvested, but the returns come in each week or month. For this reason, all the cows should not calve during any one season. On most farms the best results will be obtained by having the majority of the calves dropped in the fall, and the remainder distributed evenly in the other seasons.

The care of the bull.

The age of the bull for use in the herd is important. It has been the custom in this country to use very young bulls. This, in itself, may not be a bad practice, provided the young animal is not used too much; but to dispose of a bull as soon as he is two years old, without knowing whether or not his calves will be great producers, is unwise. He may be of great value, and should be kept long enough to demonstrate his worth.

If not properly handled, a bull is liable to become cross and dangerous. He should always be given sufficient exercise, and never teased. He should never be given an opportunity to do damage. Keep him in a well-fenced yard, and do not let him run with other cattle. He should be fed liberally on a well-balanced ration — that is, one not too fattening. By firm and kind treatment, most bulls will remain perfectly safe to handle until they are too old for service. A bull should be at his best at five to ten years of age, and yet comparatively few are kept after they are three.

The care of the herd.

There are two distinct methods of managing the feeding and stabling of a dairy herd. The first is the one more commonly used, in which the cows are pastured during the entire grazing season, and stabled during the winter, and the second in which they are kept more or less closely confined during the entire year, and furnished with green crops as much of the time as possible. This method is called the soiling system, and is not in very general use, though it has some advantages over pasturing. More cows can be fed on a given number of acres, and more of the manure can be saved. The labor is much greater, however, and it is a serious disadvantage. It is doubtful whether the extra returns per acre pay for the increased cost in handling the green crops. Furthermore, it is somewhat easier to keep cows in a vigorous, healthy condition when ranging free on pasture. [See Vol. II, pages 569-574.]

A compromise between the two systems has of late given excellent results. This consists in putting up an extra amount of silage that may be fed during the late summer months, as the pastures dry up. Nothing is better than the fresh pastures of spring and early summer, and a larger number of cows may be pastured per acre early in the season than would be possible if the pastures were to be depended on for the entire summer's feed. As the grass begins to get short and dry in August, or possibly in July, it is supplemented with silage. This makes an agreeable substitute to the cows, and they will eat it heartily, and keep up in milk

flow. Silage is also a good food for the cows that are soon to freshen, and will put them in good condition for parturition, and for heavy milking. It may be fed advantageously in the stable in connection with a grain ration. It is generally advisable to use grain in the ration, even when on pasture, unless the grass is very rich and abundant. It cannot be too strongly impressed on the mind of the dairyman that the cow must be supplied liberally with food of good quality, and with pure water in abundance, if she is to do her best.

Stabling.

Over a large part of this country, it is important that the cows be provided with shelter from the sun in summer weather. The heat and flies combine to make them so uncomfortable that doing anything like their best becomes impossible.

Over a large part of the United States, dairy cattle must be housed several months in a year. The barn should be light, well ventilated and warm enough to prevent water freezing in the coldest weather. The cows must be kept in the barn, at least in the northern two-thirds of the country, for three to six months. It is important that they be kept comfortable and healthy, and maintain good appetites. In order to do so, they must not be kept too closely housed. Fresh air and a limited amount of exercise in the open are both conducive to making the cow enjoy life, and keeping her in vigorous health. The cow should be made to enjoy living every hour of every day. Close stabling for days at a time without any opportunity to move away from the stall is not good management. For this reason it is not well to depend too much on systems of watering while the cow is standing in the stall. She needs the change and the exercise to to be derived by going out of the stable to drink. That does not mean that she should go out in the cold and drink ice-water. A sheltered drinking-tank in which the water is not allowed to become freezing cold should be easily accessible to the herd.

It has often been said that all the exercise a cow takes and all the animal heat that is used up in being turned out in the cold is at the expense of food that should have been saved or used for production. Such a statement fails to note the fact that it requires healthy, vigorous bodies to make a good use of food, and that the gain in vigor and appetite from exercise in fresh air more than offsets the loss in food. The ideal method of stabling is to furnish each cow with a box-stall. This is not practicable with the general herd. It may be done when breeding high-priced pure-breds. The common method is to tie by the neck in stanchions or by a strap. If the stanchion is used, it should be a swinging one, fastened by a short chain at each end. A good stanchion of this style will give the cow considerable freedom, and yet keep her within bounds. The old rigid stanchion should not be used. If the cows are kept properly groomed and bedded, they will be comfortable, tied in the swing stanchion and standing on a platform of wood or cement. Probably the most comfortable stall next to the roomy box-stall is one of the Bidwell or Drown type, in which the cow is not tied, but is kept in her place by a chain fastened behind her.

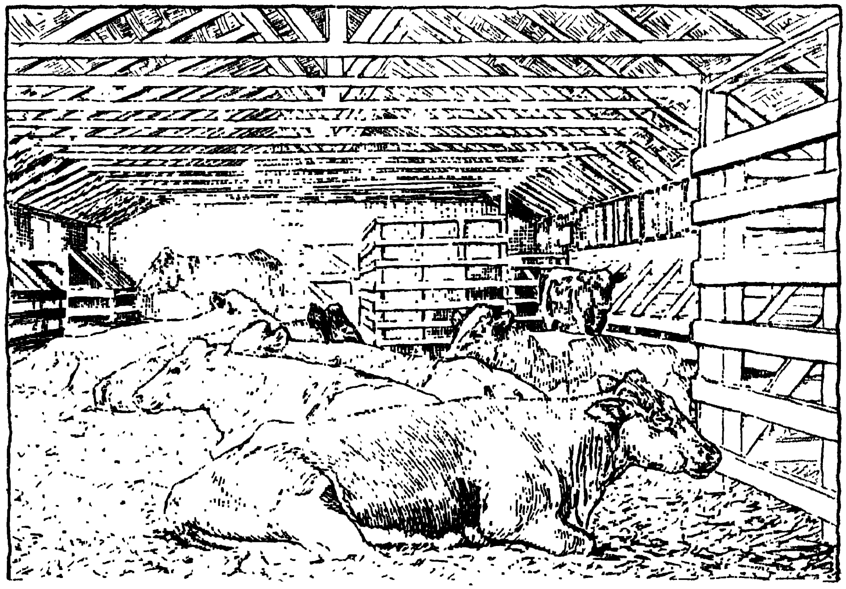

Fig. 335. A method of stable management,—the covered barnyard.

A number of successful dairymen have adopted the method of tying the cows only while milking and allowing them to run loose in a large room the remainder of the time. This room or barn, without stalling, is supplied with feed-racks and an ample watering-trough. Here the cows can move about at will and lie down in a perfectly natural position. They will be more comfortable than in any other way of stabling. This is well illustrated in Fig. 335. They should all be dehorned, or the "boss" cows may injure those that are more timid. Dehorning is good practice, no matter how the herd is stabled. [See page 150.] The length of time the cows are turned loose may be determined by each dairyman. Some will find it convenient to keep them in the stalls during the day and turn them loose at night, and others will keep them tied only long enough to milk and feed some grain. Silage may either be fed in the manger, while the cows are tied in stalls, or be put in the racks. It is probably a better practice

to feed the silage in connection with the grain ration in the mangers. Each cow can be given the proper amount in this way, and there will be no danger of the stronger ones eating too much and the timid getting too little.

This method of handling the herd saves the manure in good condition. The floor, which may be of cement or of dirt, should be kept covered with straw, or some other absorbent. This need not be cleaned out for several days, or even weeks. The constant trampling of the cattle makes a compact mass of manure that is in excellent condition to prevent loss of fertility. It may be hauled out at any convenient time. The building should be provided with large doors, so that the manure-spreader may be driven inside and loaded.

In considering methods of stabling, it should be remembered that the dairy cow needs to be kept clean. Milk is used for food, and it should be produced in as clean a way as possible. This is more easily accomplished by keeping the cows loose than in any other way, provided plenty of bedding material is used. The cows should be regularly groomed — not only for cleanliness, but because it improves the health and increases the comfort of the cows, as well as increasing their efficiency. [See pages 147, 148.]

Feeding the dairy cow.

In feeding the dairy cow, those foods should be chosen that will produce a vigorous muscular growth. In general, the dry matter of the ration should consist of one-third concentrated food, or grains, and two-thirds roughage. The average cow will make good use of seven to ten pounds of grain per day, and fifteen to twenty pounds of hay and corn-fodder, or forty pounds of silage and five to ten pounds of hay. Feed a variety whenever possible. Do not make variety by feeding one or two grains for a few weeks and then changing to another mixture, but put as many varieties as possible, or as is economical, into one mixture, and feed that steadily for months.

The great point to be considered in feeding is to keep up an even flow of milk. This can be accomplished only by regularity in feeding, and by furnishing good food in abundance. Just as the young heifers must be encouraged to milk out a full lactation period of eleven months, or more, so the mature cow should be kept up to a large flow as long as possible. It is the persistent milker that makes the big yearly record, and yearly records are what is wanted.

In feeding the calves and young heifers, good growth must be the object in view. Whole milk need not be given the calves for more than a few days. Skimmed milk, with some cooked corn meal or linseed meal in small quantities, will give rapid and vigorous growth, and produce as good a dairy cow, or even better than one that is fed whole milk and fattened from the time of its birth. Some dairymen contend that the young heifer may be fattened without any harmful result. They assert that if she has the dairy temperament the fat will soon disappear when she begins to milk. Possibly that is true, but she is more likely to have dairy temperament if the habit of using food to lay up body-fat has never been acquired. Feed the heifer for good body development. This is accomplished by using nitrogenous grains and a fair proportion of roughage. [For a full discussion of feeding, see pages 58–118 ; also, pages 313–317.]

Feeding the dairy bull.

The bull should be well fed and given daily exercise. Keep him vigorous, not fat and lazy. Put him in a tread-mill and make him walk for two or three hours per day. Feed him ground oats, wheat bran, gluten meal, oil-meal, silage and clover hay; do not make his grain ration too heavy, not more than five or six pounds per day for a 1000-pound animal.

Milking.

One of the problems that gives trouble to every dairyman who keeps many cows is how to get them milked. Hand-milking is the universal custom, and a careful milker cannot be equaled by any machine that has yet been devised. It is almost impossible, however, to secure careful milkers at anything like common farm wages, and in many places they cannot be secured at any wage. In this dilemma, the dairyman is almost forced out of business. A number of milking-machines are on the market, and their ultimate success may be considered assured. [For a fuller discussion of milking see pages 312, 313.]

Value of the individual.

In the management of a dairy herd it is important that the value of each individual be ascertained. Perhaps nowhere else does the custom of judging results by totals cause the farmer greater loss. There are thousands of cows that do not pay for the feed they eat each year, to say nothing of making a profit. These cows are kept at work because their deficiencies are hidden by the good work of other cows. The farmer is fairly well satisfied if his dairy herd shows a profit of a few hundred dollars per year, but he fails many times to realize that his profit would have been just as large or larger with only half as many cows. If those cows that are not profitable, or are actually being kept at a loss, were weeded out of the herd, the total profits would be increased. An account with each cow is easily kept. [See page 181.] It necessitates the weighing and testing of a certain number of milkings. The amount of butter-fat given in a year is the best measure of a cow's value. Fortunately, the Babcock milk test furnishes a cheap, simple, speedy and accurate method for determining the percentage of fat. The milk should be weighed from each cow three consecutive days in each month. The average for the three days is multiplied by the days in the month, and the result will be the number of pounds given per month. A composite sample should be taken of these six milkings and tested for fat. The percentage of fat secured, multiplied by the pounds of milk per month, will show the pounds of fat per month. In this way it

is soon possible to discover whether or not any particular cow is profitable. Not only does it show the value of the cow as a milker, but it gives the best of information on which to base operations of breeding.

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The Production of Milk. Figs. 336–339.

By *H. H. Wing.*

Dairy husbandry may be defined as including those branches of agriculture that have to do with the production of milk and its manufacture into butter and cheese and the various other products that may be made from it. It also includes the marketing of milk to be consumed in its original form or in the various allied products, such as cream, buttermilk, and the like.

Man has used the milk of animals as a part of his food from the very earliest times, and early learned to manufacture both butter and cheese, but the development of dairy husbandry as a special branch of industry is comparatively modern, and it is only within very recent times that the arts connected with this industry have been brought to their present state of perfection.

At various times and in various countries the milk of a considerable number of different animals has been used for purposes of food or manufacture. Of these animals, besides the cow, may be mentioned the goat, the mare, the ass, and the ewe; but, with the possible exception of the goat, the cow is the only animal that has been bred and developed to give milk in excess of that demanded by the young, and cows' milk is the chief milk used at the present time in civilized countries for purposes of food or manufacture. The amount of goats', mares', and ewes' milk utilized is so small as to be entirely insignificant. In all discussions pertaining to dairy husbandry, cows' milk, and cows' milk alone, is understood. Recently, in the United States, there has been an effort to introduce the milch goat, more particularly for furnishing milk to be consumed as such that is supposed to have certain advantages over cows' milk. The attempt, however, is still in the experimental stage. [See *Goats;* also the article on *Buffalo.*]

Dairy husbandry, as a profitable farm industry, depends very largely on the economical production of milk, and that dairyman is the most successful who produces the largest amount of milk from a minimum number of animals and at a minimum cost for food and labor. Cows with a capacity to secrete large quantities of milk for long periods of time are the foundation of a successful dairy enterprise, and it matters little how much care and skill are used in the processes of manufacture; if the cows are not good and satisfactory producers to begin with, there can be little profit.

The function of milk production is closely connected with maternity, and the production of a calf is the common and practically indispensable incentive to secretion; but the modern dairy cow has been bred and developed to give milk so far in excess of the demands of the calf, and for so much longer period of time, that, once the secretion has been induced, we may look on its continuation as depending entirely on the individual capacity of the animal and the amount and nature of the food furnished to her.

Briefly speaking, then, the secretion of milk depends on the individual capacity of the cow and the amount and kind of food-supply. Nothing is better understood by dairymen than that the variation in natural capacity to secrete milk is very great in individual animals, and that, in order to secure a satisfactory flow of milk, animals must be selected that have this natural capacity. A large number of individuals, even among those breeds that have been especially selected, bred and developed to secrete milk, fail to produce in a satisfactory way.

The average production per animal in the United States is scarcely sufficient to pay the cost of food and labor, to say nothing of interest or profit on the investment. According to the United States census reports of 1900, the average annual production per cow was 3,600 pounds of milk, equivalent to about one hundred and fifty pounds of butter. This, at $1.25 per hundred weight for the milk, or 25 cents a pound for the butter, would yield $45 or $37.50 per cow, respectively. The cost of food may be reckoned at not less than $40 per cow per year. It would seem that a cow must produce a considerable amount in excess of the average, before the owner can expect any satisfactory return for his labor or investment.

The tendency or capacity to give milk is conceded to be subject to heredity, and very much progress has been made in the last half century in developing breeds of cows that not only are large producers of milk themselves, but that transmit the tendency and capacity to give milk to their descendants in both the male and the female line. In this way there have been developed several breeds of cattle, the Jersey, the Guernsey, the Holstein-Friesian, the Ayrshire and others, chiefly distinguished for the high average production of the individuals composing them; while a few individuals in various breeds have distinguished themselves by the production of an amount of either milk or butter-fat so far in excess of the average as to entitle them to the rank of phenomenal animals. In the United States, the highest accredited yield of milk for a year is 30,318.5 pounds, made by the Holstein-Friesian cow, Pietertje 2d, from February 24, 1887,

to February 23, 1888. The largest production of butter-fat for the same length of time is 998.256 pounds, and was made by the Holstein-Friesian cow, Colantha 4th's Johanna, for the year ending December 22, 1907. The highest weekly production of butter-fat is 28.176 pounds, made from February 6 to 13, 1907, by the Holstein-Friesian cow, Colantha 4th's Johanna (Fig. 332). A daily milk yield of more than 100 pounds has frequently been made.

A yearly production of 8,000 pounds of milk, or 300 pounds of butter-fat, equivalent to 350 pounds of butter, would indicate a profitable dairy cow, and with care in breeding and selection it is not at all difficult to secure an animal that will produce this amount; and a dairyman satisfied with a less production than this could hardly be called enterprising or successful.

The dairy type.

It has long been recognized that there is a greater or less degree of correlation between the general form and outward characteristics of the animal and her capacity to secrete milk. This subject has been studied with a great deal of care, and the so-called typical dairy form has been described by many writers with a greater or less degree of particularity. As is to be expected, the supposed correlations between form and function have given rise to many theories that have not found firm foundation in fact. Nevertheless, the leading characteristics of the so-called typical dairy form are well recognized. They include, first, the wedge-shaped form, that is, a greater development of the skeleton of the hinder part of the animal, so that in outline, particularly as viewed from the side, the animal has a wedge-shaped appearance, caused by the top and bottom lines diverging from before backward; second, the angularity caused by the prominence of the bones of the shoulder, back, hips and pelvis, and by the lack of muscular development, which gives to the beef-animal its characteristic smoothness and roundness of form; third, the abundance of fatty secretions in the skin, particularly inside the ears and thighs, and along the back-bone, and at the root of the tail; fourth, the large development of the mammary gland, or udder, and the large size of the blood-vessels connected with it, particularly the exterior veins extending along the abdomen, usually called milk veins. [See pages 50, 303.]

The characteristics of the dairy form are commonly studied by means of a score-card or scale of points, in which the various characteristics are described more or less minutely. The scales of points used by the various breeders' associations and educational institutions differ somewhat, but in the main they agree very closely. [For a discussion of score-cards, the reader should consult pages 44-55.]

It should be borne in mind that the correlations between form and function in the dairy cow are not as yet reduced to so great a degree of accuracy that the form is to be taken as a better indication of the merits of the animal than her known capacity for secretion. In other words, an authentic record of the production of a dairy cow is by far the best indication of her productive capacity. This is so well recognized that the best breeders and the more enterprising breeders' associations are spending large amounts of money, time and effort in securing authentic records of production of their animals to be used as a basis for selection in the improvement of future generations.

Importance of proper feeding.

The care of the animal, and especially the food supplied to her, have a not less important bearing on the profitable and economical production of milk than the selection and breeding of the animal. Much attention has been given to the question of intelligent and rational stock-feeding, particularly along the lines of dairy production, and it is not proposed to enter into detail here further than to call attention to the fact that unsatisfactory production of milk is due to an insufficient food supply much oftener than has been supposed. While it is undoubtedly true that there are many animals that can not be made to increase their production, no matter how abundantly or skilfully they are fed, it is still true that there are many animals whose production would be materially increased, and that from being entirely unprofitable could be made profitable merely by more liberal feeding. A demonstration of this sort, made at the Cornell University Agricultural Experiment Station several years ago, showed that the milk supply could be nearly doubled in the same animals in a single year merely by more abundant food. [See pages 308, 313-317.]

Milk secretion.

The manufacture and quality of dairy products depends in large degree on the character of the milk. Hence, a knowledge of th nature, composition, and quality of milk is of importance to those engaged in the manufacture of products from it.

Milk may be defined as an emulsion of fats in a watery solution of milk-sugar, proteids, and salts. It is an opaque, yellowish white fluid, with a faint alkaline reaction, and a slightly sweetish taste. It is a true animal secretion, formed in the mammary gland, partly by transudation or osmosis directly from the circulation of the animal, and partly by metabolism taking place in the cells composing the tissue of the gland itself, the exact manner of the formation of its various constituents being more or less uncertain. [See *Milk as a Market Product*, pages 176-187.]

The mammary gland, or udder (Figs. 336, 337), is a spongy mass of tissue situated without the body cavity and held in place in a fold of the skin by a network of fibrous bands. It is a double organ, and in the cow each gland is partially subdivided into two parts, called quarters, each furnished with a single orifice or teat. The essential parts of the gland are a system of canals or ducts, originating at or near the orifice and extending by subdivision all through the mass of udder and ending in a group of secreting follicles or acini. The whole structure is abundantly supplied with blood-vessels, nerves, and lymphatics, and is bound together with a mass

of connective tissue in which there is deposited more or less fat.

The prime, but by no means indispensable incentive to the secretion of milk, is the birth of young by the animal. Cases are not uncommon in which milk has been secreted by virgin animals, and

Fig. 336. A well-formed udder.

Fig. 337. A poorly formed udder.

instances are on record in which it has even been secreted from the rudimentary glands of the male. For some time before the birth of the young, the udder takes on a gradual enlargement, which increases rapidly for a few hours, or occasionally a day or two before birth. In case of the cow, milk usually appears in the udder before the birth of the calf, but not often to any very great extent.

Immediately after birth, there can usually be drawn from the udder, several quarts of milk, which is, however, quite distinct in character from that secreted later. This first milk is known as colostrum. It is thicker, denser and more viscous and higher colored than normal milk. It is characterized by a much less content of water, by the fact that the fat is variable and sometimes much higher, but often considerably lower than that of normal milk; but chiefly by the character of the proteids. Colostrum milk contains large amounts of albumin and comparatively small amounts of casein. It also contains a greater or less number of microscopic bodies known as colostrum corpuscles, which are supposed to represent the contents of the recently broken down tissue, and in some cases the colostrum contains more or less of tissue debris. Colostrum has a more pronounced odor and flavor than the normal milk, and is considered unfit for consumption or manufacture. It cannot, however, be considered in any sense injurious, and it has a laxative effect which makes it particularly useful for the young animal. It is unfit for manufacture into butter and cheese mainly because of the mechanical difficulties interposed by the presence of the large amount of albumin. As the flow of milk becomes established, the milk gradually loses its colostrum character, and in the course of a few days takes on its normal characteristics. The proportion of albumin in colostrum is sufficient to coagulate the whole mass if it is heated to a temperature of about 180° Fahr. When the proportion of albumin is reduced to such an amount that the milk no longer thickens when it is boiled, it is ordinarily taken to have changed from colostrum to normal milk. This may occur as quickly as the third milking after parturition and is seldom delayed beyond the eighth or ninth, unless there is serious inflammation of the udder or some other constitutional disturbance of the animal.

Of the various constituents of milk, the water, fibrin, albumin and salts are transuded directly from the blood-vessels in the walls of the secreting follicles into the cavity of the follicle, and so find their way into the milk-ducts and finally to the orifice. Casein, fat, and sugar are not found in the blood, and they are generally considered to be metabolic products formed from the constituents of the blood through the metabolic activity in the cells making up the tissues of the follicles. It has been affirmed that in the formation of these substances, it is necessary that there should be a rapid cell growth and destruction in the tissue of the gland. Whether this is necessary or not, the secretion of the milk is undoubtedly accompanied by great cell activity.

For a short time after calving, the amount of milk secreted increases until a maximum amount is reached, which is usually within a month of calving. From this time on, the flow of milk is maintained with a good degree of regularity for several months, and in exceptional cases may continue without material falling off for a year or more. The continuation of the flow depends on several conditions. In the first place, there is a natural tendency for the flow to decrease, due to the shrinking of the blood-vessels in the udder, and a consequent less flow of blood in this direction. This tendency is increased after the cow has again become pregnant, and in many cases a noticeable falling off in the flow of milk occurs about this time. The character of the food and the regularity and thoroughness of milking are also important factors in maintaining the flow of milk. In order

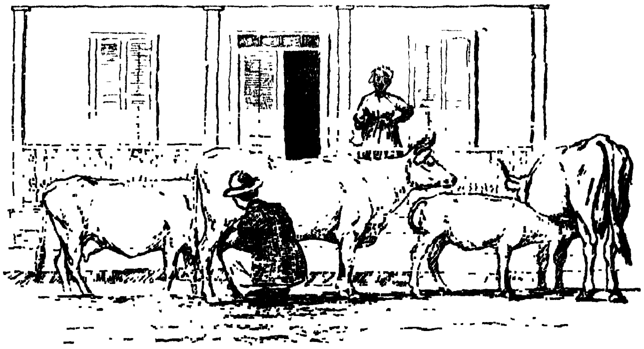

Fig. 338. A traveling dairy, as seen in parts of the Old World and Spanish America, and also in Key West, where this picture was taken.

to maintain the flow of milk without shrinking, it is not only necessary that the animal be abundantly fed, but the character of the food is also an important factor. This is particularly the case in cows that drop their calves in the spring, for as

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the grasses grow harder, and the pastures less abundant in late summer, the tendency to shrink from this cause occurs at about the same time that the cow again becomes pregnant, and the milk-flow notably diminishes. Succulent, easily digested food, particularly after the fourth or fifth month of lactation, is a great aid in maintaining the flow of milk.

Milking.

The secretion of milk is also influenced by the milker and the attitude of the animal toward him. The milk-ducts in the udder are provided at various points with more or less well-developed sphincter muscles, or valves, that are connected with the muscular system of the animal, and are more or less under her control. Any fright or disturbance of the animal at or near the time of milking is likely to be followed by contraction of these muscles, and the animal "holds up her milk." On the other hand, if the milker is kind and gentle, in many cases the cow seems to transfer to him some of the affection she would naturally bestow on her offspring, and the milk is not only given down freely, but there is reason to suppose its secretion may even be stimulated. Experiments have shown that certain persons are able to secure more milk from certain cows than others, merely through the personality of the milker, and not because of any superior skill.

Regularity of milking is also an important factor in maintaining the flow. If the milking is irregular, so that the udder becomes over-distended with milk, this causes an irritation that results in a marked shrinkage of secretion.

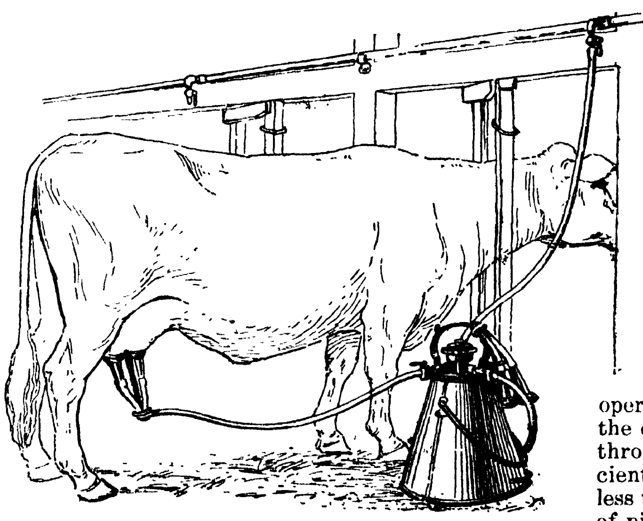

Fig. 339. Milking machine in place.

The quantity of milk secreted is also to some extent determined by frequency of milking, and cows will give more when they are milked at frequent intervals. This factor acts only within narrow limits, and the point is soon reached when increased frequency of milking is not followed by increased production. While there is little experimental evidence at hand on this point, the opinion of careful dairymen is that the greatest quantity of milk is secured when the interval of milking is so timed that the udder becomes moderately distended between each two milkings. Most cows will give rather more milk if milked three times a day than they will if milked only twice, and in cows secreting large amounts—eighty pounds or more—there is an increase in production if the cows are milked four times rather than three times a day. The common practice, of course, is to milk only twice a day, and it is better if the intervals are timed as nearly as possible at twelve hours apart.

The frequency of milking also has a certain effect on the quality of the milk, notably the percentage of fat, and it is noted that there is a tendency for the percentage of fat to rise when the cows are milked frequently. Like the amount of milk, this effect does not continue when the milkings are very frequent. The most notable case of this sort is that when the cows are milked twice a day at unequal intervals in the great majority of cases the percentage of fat is decidedly higher at the milking following the shorter period. Even this is not universally true. It is the common opinion that the secretion goes on more rapidly while the animal is being milked, and the conditions most favorable to a large secretion favor milking as rapidly as possible, without discomfort to the animal, and with a more or less stroking motion on the udder, especially toward the last.

The operation of milking gives opportunity for considerable skill, and a rapid, careful, skilful milker will do very much toward increasing the amount of milk that an animal will give during the period of her lactation. Milking, however, is laborious, and, to many, irksome; so that in large dairies it is often difficult to secure skilful milkers. This has given rise to the attempt to devise machines for removing milk. While many apparatuses have been devised for this purpose, none has been at all successful until very recently.

Milking machines (Fig. 339).

The only milking machine in America that can be said to be at all successful at the present time is the Burrell-Lawrence-Kennedy. It operates by an intermittent exhaust on the teats of the cow. Its successful operation requires a power, through vapor or steam engine, or otherwise, sufficient to maintain a vacuum pressure of somewhat less than twenty pounds to the square inch, a system of pipes leading to all parts of the stable, with an outlet between each two cows, and the milking machines themselves with their tubes and connections. The milking machine consists of a pail, on which is fitted, air-tight, a lid on which is the "pulsator." It is furnished with rubber connections on the one hand to the exhaust pipe, and on the other to the cow's teats through the medium of carefully fitted "teat cups." The pulsator is an ingenious arrangement of cylinders and valves by means of which the vacuum pressure on the pail is

intermittently and automatically increased and decreased. This change of pressure transmitted through the tubes to the teat cups simulates the sucking action of the calf's mouth on the teats, and so serves to draw the milk from the udder into the pail. Each machine is fitted with connections for two cows, and a single operator can manage two or three machines at the same time, thus milking four or six cows at once. The time required to draw the milk from a cow is little if any less than is required to draw it by hand. These machines have been in operation now for several years in a more or less experimental way, and their present status is about as follows: The expense of equipment with an outfit of three machines is not less than $500, so that their use is not economical in a dairy of less than thirty cows. The mechanical parts of the machine are fairly perfect and durable, and work with a good degree of reliability; nevertheless, some little mechanical skill is desirable in the operator. The machine will draw the milk uniformly and completely from the great majority of cows. An occasional cow cannot be milked, and frequently more or less milk is left in the udder. Most users of milking machines practice hand-stripping afterward. Some users complain that their cows tend to go dry sooner when milking machines are used. The efficacy of the milking machine depends to a good degree on adjusting the teat cup carefully to the size of the teat. Several sizes of teat cups are provided, and either the cows must be arranged in the stables according to the size of the teat, or the teat cups must be changed frequently. The milk is drawn into a covered pail and is not exposed to the air of the stable, which is a factor of considerable importance in securing clean milk. The milking machine is equipped with numerous closed rubber tubes and other parts that are not easily kept clean without constant care and attention. It is said, however, that by the use of antiseptic solutions the difficulty in keeping the machine clean is not great.

Literature.

For literature concerning the physiology of milk secretion, see R. Meade Smith, Comparative Physiology of Domestic Animals; Aikman, Milk: Its Nature and Composition; Martiny, Die Milch; Kirchner, Milchwirttischaft; Wing, Milk and Its Products.

Feeding Dairy Cattle. Figs. 340–342.

By *F. W. Woll.*

The feeding of dairy cattle in its relation to milk production has received considerable study, but much remains to be learned. It is the purpose of this article to set forth in a brief way only a few of the important facts that have been gleaned. Publications devoted especially to the subject should be consulted for fuller details. [See references to literature at end of article.]

The dairy calf.

In the feeding and the development of the dairy calf, feeds of a fattening tendency are to be avoided, and only such fed as tend to develop a vigorous muscular system. With this end in view, the feeding of full milk to the dairy calf is discontinued after a few days, especially in case of milk rich in butter-fat, and separator skimmed milk is fed in its place, the change from one feed to another being made gradually, so as not to give rise to digestive disorders. A small quantity of some concentrated feed, as shorts, linseed meal or flaxseed meal boiled into a jelly with water (one part meal to six of water), is fed daily with the skimmed milk. If the milk is not fresh from the separator, it must always be heated to blood-heat before being fed to the calf. If, however, a practice of feeding

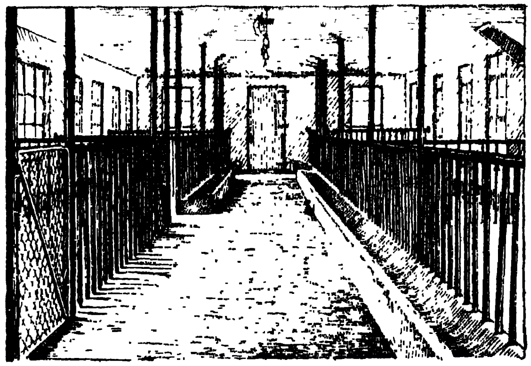

Fig. 340. Young-stock stable. Showing arrangement of stanchions and mangers in a dairy-barn.

cold milk is followed, and the milk is always cold, but not ice-cold, no injurious results will follow, provided, of course, the change has been gradual from the warm mother's milk. It must be kept in clean pails. Cleanliness is, in general, a most important factor in calf-feeding.

The amount of meal added to the skimmed milk is gradually increased in the first three weeks to about one pound a day. At six or eight weeks old, other feeds are given, preferably oats, wheat middlings, or a mixture of both, and at about three months old these feeds should gradually replace the more expensive concentrates for the sake of economy. Some feeders report good results from feeding farm grains with skimmed milk after the first week. The calves will gradually learn to eat hay, if it be placed before them; a fine quality of clover hay or early-cut hay is generally reserved for this purpose. The object in view throughout the first year should be to keep the calves in a healthy growing condition, and to feed only easily digestible feeds that will cause a rapid, normal growth without deposition of unnecessary body fat. Other desirable foods for older calves than those mentioned are mill feeds, oil-meal, small grains, especially barley, brewers' and distillers' grains, malt-sprouts, and the like. Cottonseed meal, on the other hand, should be fed only sparingly or not at all.

Fall calves, as a rule, are to be preferred to spring calves on dairy-farms, both because they can receive better care and attention during the winter months than in summer, and because they

will go on pasture in the spring at an age when their digestive apparatus is developed so that the green grass may form their main food, supplemented with some grains when pastures are scant. The time of calving of cows in a dairy herd, however, must be distributed over the year to some extent, so as to insure a fairly uniform milk supply throughout the year.

The dairy heifer.

The practice of good dairy-farmers as to time of breeding heifers differs considerably. The best results, however, may be expected by breeding so that the heifer will come in at about two years of age. A persistent milking habit is favored by continuing to milk the heifer for about ten months during the first lactation period, if possible. As the time of parturition approaches, the feeding of the heifer should be plain, without stimulating foods that may have a deleterious influence on the fœtus and cause abortion, as fermented or decayed feeds. Good, clean hay from clover or mixed grasses, corn fodder, corn silage (made from well-matured corn, and fed in small or medium quantities, not to exceed twenty-five to thirty pounds a day) or roots should form the main reliance; preferably both dry and succulent roughage is fed, and, in addition, small amounts of ground oats, bran, shorts, gluten feed or corn, the last feed being given only when the heifer is in poor flesh. Shortly before calving, the feeding of all grain feeds, except perhaps a couple of pounds of bran, is discontinued, and dry roughage and roots (or a little good silage) are fed till the cow freshens. Directly after calving, a warm, thin slop of oat-meal, bran, or shorts, is given, or warm water only; for a few days until the danger of fever is over, the amount of feed should be very light, and gradually increased for two to three weeks, when the cow may be put on full feed. By this time, or before, the maximum production of butter-fat, and generally also of milk, will be reached.

A heifer with her first calf should receive special care and be fed liberally, since she is growing and producing milk at the same time. A good supply of protein feeds must be furnished in her ration to meet the requirements of the body for nitrogenous food components. Corn-meal is especially valuable at this time for heifers that show a tendency to "milk their flesh off." This heavy feeding should be continued up to drying-off prior to the second calving. Further details as to methods of feeding will be found below, after a more general discussion of problems connected with the feeding of dairy cows.

The dairy cow.

Before explaining the method of feeding dairy cows, some general principles connected with the subject should receive attention, in order that we may more clearly understand the special problems that present themselves under the varying conditions of the different sections of our country.

Feeding standards.—The studies of the principles underlying the nutrition of farm animals which were made, especially by German scientists, during the middle and the latter part of the last century, crystallized into so-called "feeding standards" that show the quantities of total dry matter and of digestible food components required daily by farm animals under different conditions as to age, weight or production. Of these, the standards proposed by the German investigator, Emil V. Wolff, have become best known in this country, and are generally referred to as the Wolff or simply the "German feeding standards." The Wolff standard for dairy cows provided for 24.5 pounds of total dry matter in the daily feed of a dairy cow, and for a content of 2.5 pounds of digestible protein, 12.5 pounds digestible carbohydrates, .4 pound digestible fat; nutritive ratio, 1:5.4.

Up to within recent years it was generally thought that this standard was equally applicable to all milch cows, and to conditions in the new world, as well as in the old, as was the case with those proposed by the same scientist for other classes of farm animals. It was first shown by investigations made in this country in the early nineties that the rations fed by practical American dairymen in different parts of our country contained, as a rule, considerably more starchy components than called for by the Wolff standard, and were, therefore, of a wider nutritive ratio than this standard. During the past dozen years, evidence furnished by both careful investigations and practical experience has gradually accumulated, showing that the exact nutritive ratio of the ration of a dairy cow, or the amount of digestible protein which it must contain, is not a matter of the great importance it was long held to be, provided a good supply of total digestible matter and a certain minimum of digestible protein be supplied in the food of the cows. The amount of the production of dairy cows is the controlling factor as to the quantity of digestible food materials they require, and large producers must receive considerably heavier rations than cows that are nearly dry, or than poor milch cows. The rations fed cows of different productive capacity, or to the same cow at different stages of its period of lactation, therefore, must differ radically as to quantities, but not necessarily, or to the same extent, as to quality.

As regards the nutritive ratio of the rations, it may vary from 1:5 to 1:9 without greatly influencing the quantity or the quality of the production of the cows; ordinarily, however, somewhat better results are obtained, under otherwise similar conditions, by feeding rather narrow rations than wider ones. Such ratios will favor the production of a maximum milk yield, of the best quality that the cow is capable of producing, but the effect of the character of the ration on the fat content of the milk is not very marked.

The fact that the manurial value of nitrogenous stuffs is higher than that of starchy feeds, furthermore, adds to the value of rations of relative narrow nutritive ratios, as it renders the manure from cows fed such rations more valuable than in the case of low-protein rations. The market prices of the different classes of feeding-stuffs are the

main factors that will decide how narrow nutritive ratios can be profitably fed in different localities; where nitrogen feeds are relatively cheap, they can enter more largely into the make-up of the rations than where the opposite conditions obtain.

We may say, in general, that a good dairy cow in full flow of milk should receive twenty-five pounds of dry matter, fifteen to eighteen pounds of digestible matter, and at least two pounds of digestible protein. Cows of large productive capacity may be fed to advantage considerably larger quantities of food materials than those given, while low producers, or dry cows, require much less. For dry cows, rations containing less than twenty pounds of dry matter, twelve pounds of digestible matter and one and one-half pounds of digestible protein are ordinarily sufficient to maintain body weight and insure a normal development of the fœtus, if they are in calf.

In discussing the feeding of dairy cows, we may conveniently consider separately the summer period when the cows are pastured or fed soiling crops, and the winter period, when they are fed winter rations in the stable.

(1) *Summer-feeding of dairy cows.*—The favorable influence of early summer pasturage on the milk secretion of cows, both as regards yield and quality, and more especially its fat content, has been known to observing dairy-farmers as long as milk records have been kept or tests of milk have been made. Ample pasturage is one of the essentials of successful dairy-farming where the soiling system has not been introduced. In the early part of the season, the cows, as a rule, will find a sufficient food supply on the pasture alone; but, later in the season, it will often be necessary to supplement the pasture with soiling crops or summer silage, or, if neither is available, to feed grain feeds. Trials at a number of experiment stations have shown that the feeding of grain to

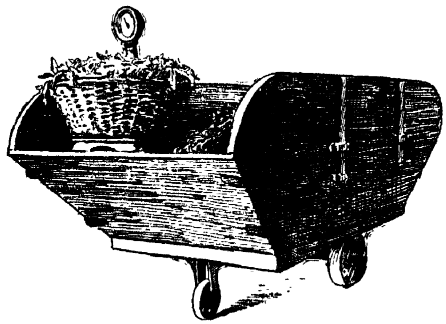

Fig. 341. Truck used in handling rough feed and scale for weighing same.

cows on pasture is profitable only when there is a scarcity of pasturage. In the case of heavy milkers, however, it will be advantageous to feed at least a few pounds of wheat bran, or wheat bran and oats, throughout the season, in order to insure a maximum production.

Soiling.—The use of soiling crops or summer silage on dairy-farms is an important feature of intensive dairy-farming, as two to three times as much green forage may be secured per acre by this system as by pasturing, and it enables the farmer to maintain, so far as possible, the milk production of his herd during the trying "fly time," when hot weather and flies combine to reduce the production of the cows, both for the time being and for the remainder of the lactation

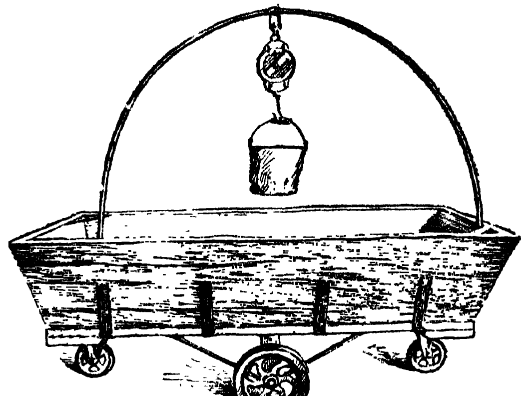

Fig. 342. Truck and scales used in weighing grain feeds.

period. A variety of soiling crops is fed in different sections: corn, alfalfa, peas and oats, rye, rape and the like. Some of these crops, as rye, rape and oats, should be fed with care, in small quantities at the start, and always after milking, so that they will not give rise to bad flavors in the milk or the products made therefrom. [See *Soiling*, Vol. II, p. 569.]

Summer silage is a highly-prized feed on many American dairy-farms. Generally a small, separate silo is filled in the fall for the purpose of feeding the silage in late summer, when drought and hot weather are likely to cause serious damage to pastures. The more common silage crops are corn, red or other clover, and alfalfa, corn being of most importance in the greater part of agricultural America. Thirty pounds of soiling crops or silage is an average allowance for dairy cows on poor pastures, and as much as sixty pounds of soiling crops or forty pounds of silage may be fed in the case of large cows, during seasons of drought when pastures are scant.

(2) *Winter-feeding of dairy cows.* — The cows are fed in the stable during one-half of the year or more, and as the system of feeding during this period is necessarily most expensive, the profit of the dairy will depend to a large extent on the economy of the winter-feeding. Economical feeding in cases of good dairy cows does not mean scant supplies, but the kind of feeds and feed combinations that will be likely to produce best results for the least money. Only cows that respond to liberal feeding and are fed liberally will prove profitable dairy animals.

No detailed discussion of feeding-stuffs adapted to the feeding of cows will be given in this article, since the characteristics of the different kinds of feeding-stuffs and separate feeds are discussed

elsewhere. [See pages 58–118.] A few general suggestions, however, may prove helpful.

Succulent feeds, whenever possible, should be provided for dairy cows during their entire lactation period; silage and roots are the main available feeds of this character during the winter period, and in corn-growing sections, at least, the former has been found to yield the largest and cheapest quantities of food materials per unit of area. Roots, however, are valuable substitutes when there is no silo on the farm; they are fed especially in Canada and by farmers who adhere more or less to European methods of agriculture. In the case of heavy producers and cows "out of condition," roots are often fed, because of their dietetic effect, as appetizers, and because of their favorable influence on the digestion of animals.

Corn silage.—The silo enables dairy-farmers to utilize the large supply of food material in the corn plant with the least possible loss and expense. For this reason, and because of the advantage of having a palatable, highly nutritious and relished succulent feed conveniently at hand throughout the season, the silo is now generally regarded as next to a necessity on dairy-farms, at least in corn-growing sections. The whole corn plant, ears and all, as a rule, is run through a feed-cutter, this having been found the most economical method of handling the crop. The corn is harvested when nearly ripe, and cut into one-half- to three-fourth-inch lengths in filling the silo.

Silage is greatly relished by cows and can be fed in large quantities if made from well-matured corn. Ordinarily, the best results are obtained when not over forty pounds of corn silage is fed per head daily, and it is always fed with some dry roughage, either hay or corn fodder. Since the corn plant is rich in carbohydrates, protein feeds, as clover hay, wheat bran or oil-meal, should always be fed with corn silage or corn fodder. Clover silage, alfalfa silage, and the like, are fed in somewhat smaller quantities than corn silage. [See *Silage-Cropping*, Vol. II, page 566.]

Dry roughage.—Hay from the grasses or legumes is a common coarse cow feed in this and other dairy countries. Early cut hay is more valuable, ton for ton, than late cut, but the yield obtained will be somewhat lower in the former case. Clover hay, or hay of other legumes, stands first in value as dry roughage for dairy cows. It is preferably fed long. Pure timothy hay is a poor cow feed, especially if late cut; mixed timothy and clover hay is the more valuable for cows the less timothy there is in it. Among other kinds of hay that are fed and relished by dairy stock are millet, oat, sorghum, alfalfa and pea.

Corn stover (corn-stalks, corn fodder) is fed on the best American farms whole or cut, after having been shocked in the field. By the primitive method of feeding corn-stalks, in which the stalks are left standing in the field and the cows are sent out to nibble off the leaves and stalks during the fall and winter, less than one-half the food value in the stalks is utilized. Even when the shocks are left in the field, exposed to rain and weather for only a couple of months, not less than one-fourth to one-third of the original food material in the stalks is lost. This loss can be partially avoided by placing the cured fodder under shelter and feeding it cut, but the most convenient and economical method of utilizing the corn crop on most American dairy-farms, doubtless, is to place it in a silo and feed it as silage.

Straw of the small grains is not often fed to dairy cows in this country, as we have an abundant and cheap supply of roughage in corn-stalks. When a quantity of fine, bright oat-straw is available, it is well worth feeding in moderate quantities, not to exceed one-half the weight of total dry roughage fed. The different kinds of straw are valued for feeding purposes in the following order: oat-, barley-, wheat- and rye-straws.

Concentrated feeds (*"concentrates"*).—The common concentrated feeds used on American dairy-farms are the cereals and mill refuse, starch or glucose factory refuse, brewery and distillery feeds and oil-meals, especially linseed and cottonseed meals. The amounts of these feeds that can be fed to dairy cows with profit will depend on the price of the feeds, the production of the cows, and the prices obtained for the products sold. In general, the carbohydrates of feed rations are supplied by farm-grown crops, while nitrogenous feeds are largely purchased, except when leguminous crops, as the clovers, alfalfa, peas, beans, and the like, are grown. By the culture of crops of the latter class, the amount of protein foods that it will be necessary to purchase will be reduced to a minimum. Bran may be partially replaced, nearly ton for ton, by carefully cured alfalfa hay, or by five to six tons of pea-vine silage. Roughly speaking, the cereals may be considered of equal food value for dairy cows, and of about similar value as bran or shorts, in the rations ordinarily fed. Cottonseed meal, gluten meal and oil-meal likewise possess nearly equal food value, with the first two feeds occasionally ahead. The comparative value of different feeding-stuffs, however, depends, to a large extent, on the combination in which they are fed, a starchy feed being of greater value to a farmer having a good supply of protein feeds, than to one who has mainly starchy feeds to select from.

The quantities of grain feeds fed by American dairy-farmers vary considerably, from a few pounds to as much as eighteen pounds per head daily. Only exceptionally large producers will give economical returns for more than six or eight pounds of grain feed daily, with abundant roughage of good quality at hand. It is a good rule to feed as many pounds of grain feeds a day per head as the cow produces pounds of butter-fat during the week, and to feed as much roughage in addition as the cow will eat up clean.

Rations for dairy cows.—It is important in making up rations for dairy cows, as for other classes of farm animals, to see to it that a liberal amount of easily digestible substances is supplied; nearly one-half of the dry matter of the ration should be supplied in the form of concentrated feeds in case

of milch cows, the amount fed being governed primarily by the production of the cows. No moldy or decayed feeds should be fed, and, in the case of wet feeds, particular attention must be given to keeping clean the mangers and the premises about the stable. A variety of feeds is always fed to dairy cows, often as many as half a dozen different feeds, so as to stimulate the appetites of the animals. The modern dairy cow is the product of special-purpose breeding and high feeding, and unless special pains are taken to cater to her wants, she will not be able to reach and maintain the high standard of production which may reasonably be expected of her.

The time of feeding is also important. The feeding should be as regular as the milking. Many farmers feed either hay or grain directly before or during milking, but as a rule, this is not to be recommended, both because of the tendency it has to interfere with the letting-down of the milk and the danger of contamination of the milk with dust and bacteria that it involves, especially when hay is fed that way. A good order of the day's work in the dairy-barn during the winter is as follows: First, in the morning, milking, then feeding grain, feeding silage, cleaning gutters, watering, feeding hay, grooming, turning out in the yard (on pleasant days for one or two hours in the early afternoon), watering, cleaning stable, feeding grain, milking, feeding silage, and arranging bedding.

The following twelve rations for milch cows are given as samples of the systems of feeding to be recommended in different parts of the country (for further discussions of rations, see references below):

(1) Hay, 20 lbs.; oats, 3 lbs.; corn-and-cob meal, 3 lbs.; oil-meal, 2 lbs.

(2) Hay, 10 lbs.; corn-stalks, ad lib.; wheat bran, 3 lbs.; corn meal, 2 lbs.; cottonseed meal, 2 lbs.

(3) Roots, 60 lbs.; stover, ad lib.; oats, 3 lbs.; bran, 3 lbs.; gluten feed, 3 lbs.

(4) Corn fodder, ad lib.; corn silage, 40 lbs.; shorts, 2 lbs.; dry brewers' grains, 2 lbs.; oil-meal, 2 lbs.

(5) Silage, 40 lbs.; hay, ad lib.; bran, 4 lbs.; oats, 2 lbs.; gluten meal, 2 lbs.

(6) Corn silage, 45 lbs.; hay, ad lib.; oats, 4 lbs.; oil-meal, 2 lbs.; cottonseed meal, 1 lb.

(7) Corn silage, 35 lbs.; clover hay, ad lib.; bran, oats and corn meal, 2 lbs. each.

(8) Clover silage, 25 lbs.; hay, 5 lbs.; corn-stalks ad lib.; oats, 3 lbs.; corn meal and oil-meal, 2 lbs. each.

(9) Clover or alfalfa silage, 30 lbs.; hay, ad lib.; bran, 4 lbs.; middlings, 3 lbs.; oil-meal, 1 lb.

(10) Alfalfa hay, 20 lbs.; oats, 4 lbs.; corn meal, 2 lbs.

(11) Hay 20 lbs.; cottonseed hulls, 10 lbs.; cottonseed meal, 4 lbs.; wheat bran, 2 lbs.

(12) Corn silage, 30 lbs.; cottonseed hulls, 12 lbs.; bran, 6 lbs.; cottonseed meal, 3 lbs.

The dairy bull.

The bull at the head of a dairy herd should receive a large share of his food in the form of dry roughage, hay from grasses or legumes, corn-stalks, and the like, with only limited amounts of concentrated feeds. Of the latter, wheat bran, shorts, oats and a little corn meal are to be preferred. Roots are good as a relish, while corn silage and other kinds of silage should be fed very sparingly to breeding bulls. Fattening foods and excessive grain-feeding should be avoided, so that the animal may be kept in a vigorous active condition. All corn and other fattening feeds for this reason are to be fed with care; high feeding and a lack of exercise are common causes of impotency in bulls; a wrong system of feeding management has been the cause of shortening the period of usefulness of many bulls.

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Feeding Beef Cattle. Figs. 343–345.

By *Howard R. Smith.*

In the production of beef in America there are two systems in practice: (1) breeding and fattening cattle in the farming or grain-growing sections; (2) breeding and growing cattle in the grazing districts, and transporting them later to those parts of the country devoted to the growing of grain, where they are fattened for market. Extending from north to south through the western part of North America, adjoining and including the mountain ranges, is a wide stretch of country unfit for farming purposes, because of its physiography and, particularly, its lack of rainfall. While much of this land has little or no market value, it produces nutritious grasses, which will furnish sustenance to a limited number of cattle, sheep, or horses, animals that are adapted to travel over a considerable area to gain access to water and sparse vegetation. The conditions which prevail in this so-called range country are such as to make the cost of feeding an animal one year a matter of small expense, and it is because of this that cattlemen on the plains keep the offspring of their herds until fairly mature in frame though thin in flesh. It will also be understood, that when cattle thus reared are purchased by farmers at the ranches where grown, or at stock markets, they should be fed and handled in a manner somewhat different from those bred on farms.

The farmer is not justified in keeping cattle of his own raising until they are three or four years old, as is done by ranchmen. The price of farming lands would not warrant such a procedure. It is a well-established fact that the older and larger an animal becomes, the more food is required for body maintenance,—for body heat, heart action, lung

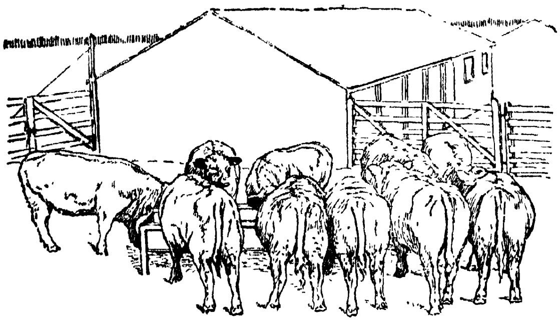

Fig. 343. Farm-grown two-year-old steers, feeding in winter.

expansion, and other functional activities,—and consequently an increasing amount of food is required for a given gain. In a general way, the two-year-old steer will require approximately one-third more food for a given gain than will the yearling, and the three-year-old one-third more than the two-year-old. This is also true with cattle on the range, but there the extra food required in later years is offset by the smaller percentage of calves produced from a range herd of cows compared with a herd on the farm. Moreover, farm cows are kept primarily for milk and secondarily for calves, and it is to the interest of the farmer to keep more cows and correspondingly fewer steers. Farm-grown stock, therefore, should be fattened as baby-beeves, yearlings, or twos.

Baby-beeves.

Baby-beeves are cattle that are finished for market at the age of ten to sixteen months. This industry is now made possible by the fact that we have types of cattle that can be made fat at that early age. It is also encouraged by the packing-house buyers through their willingness to pay as much per hundred weight for young fat cattle as for older ones in the same flesh. Feeding for baby-beef is no doubt most practicable on farms that are partly devoted to the keeping of cows, or breeding ewes, animals which utilize the surplus roughage ordinarily grown on farms. Baby-beeves require heavy grain-feeding from start to finish, and it is evident that this form of beef production would be less profitable if grain were scarce and high in price and rough feed a drug on the market. It requires beef-bred bulls of low and compact build to produce calves suitable for baby-beef. There is a larger proportion of individuals of that type among Aberdeen-Angus and Herefords than other breeds, and these are also early maturing.

Calves that have had an abundance of milk from the dam, and liberal rations of grain both before and after weaning, can be made into prime baby-beef as early as ten months of age, though it is customary to feed a few months longer than this. The object is to hold the milk flesh and put on more besides. Corn is to be largely depended on, both because of its cheapness and because of its fattening character, rich as it is in starch and oils. It gives best results, however, when fed with some food rich in protein, as, for example, oil-meal or gluten feed. Whenever the market price of oats is on a par with corn per hundred, it is well to make the grain ration about one-fourth oats by weight. This grain, because of its bulk, serves to make a heavy feed of corn more permeable to digestive juices, and less likely to cause founder. In fact, one could afford to pay perhaps ten cents per hundred more for oats than for corn, for the sake of having a small quantity to mix with corn. If bran is fed, oats can be dispensed with. Furthermore, bran will furnish more protein than oats, but its price is often such as to make it a more expensive source of protein than oil-meal, the latter being three times as effective as bran for that purpose.

A calf intended for early baby-beef, given all the grain he wants, and weighing 400 to 500 pounds at six months, will consume per day approximately five pounds of corn, two pounds of oats, and one-half pound of oil-meal, and such a ration with plenty of good clover or alfalfa hay should give excellent results, if supplied regularly. With roughage other than the legumes,—clover, alfalfa, or cowpeas,—the oil-meal should be increased to one pound per day. The same weight of bran could be substituted for the two pounds of oats and the one-half pound of oil-meal, if more available. The market does not countenance poorly finished baby-beeves, and it is therefore necessary to increase the daily ration as fast as it will be consumed by the calves, although it is never desirable to put in the feeding bunks more than will be cleaned up between the two feeds, morning and late afternoon. Corn silage is proving popular for calves, because of its succulence and its tendency to prevent digestive disorders resulting from heavy grain-feeding. The feeding can be made lighter early, if the calves are not to be finished until sixteen months of age.

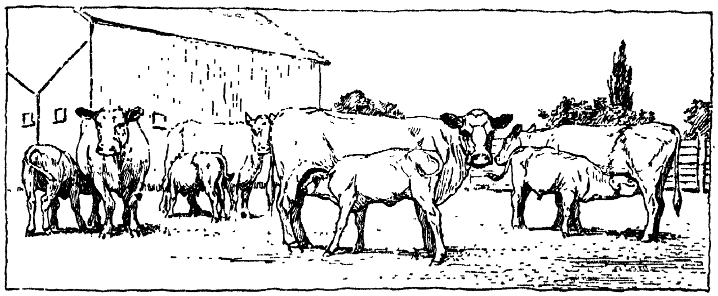

Fig. 344. Aberdeen-Angus calves nursing.

Skimmed-milk calves, although thinner at weaning time, are sometimes sold as baby-beef if well fed until sixteen or eighteen months of age. Heifer calves are preferred because they seem to take on flesh earlier than do male calves. In fact, the use of heifers for baby-beef production is the best solution of the heifer problem, because young heifers are discounted at the markets much less than are older heifers often well along in pregnancy.

Long yearlings.

Fattening long yearlings,—cattle eighteen to twenty-three months old,—promises to be a popular method of producing beef on farms having an abundance of good summer pasture. It is a method less to the extreme than baby-beef production, yet having to some degree the same advantages, notably, larger gains per food consumed and quicker returns than are made by keeping cattle until older. It is ahead of baby-beef production in that more beef is made from hay and grass and the final weight represents a relatively smaller consumption of grain.

Taking it for granted that the calves are born in the spring, they are given little or no grain before or after weaning from the pail or the cow, as the case may be. A luxuriant growth of grass is depended on for the fall months, and when winter sets in the calves are supplied with a small allowance of grain in addition to a liberal feed of hay. It is intended that such calves shall be given pasture without grain the following summer and a full feed of grain the next fall and winter. With such a course mapped out for them, it would seem that the winter ration should be such as to make their going on pasture the following summer a pleasure rather than a hardship. This would not be accomplished were a heavy winter grain ration dropped when the cattle go on grass.

In this connection, the results of a test made at the Nebraska Experiment Station with fifty grade Hereford calves averaging 500 pounds each, are of interest. One lot was fed liberally on hay, mostly alfalfa, and no grain; another lot, the same kind of hay, though less of it, and three pounds of grain each per day; while a third lot was given still less of the same kind of hay and six pounds of grain each per day. The last-named lot made the largest and most economical gains during the winter, but the discontinuance of grain on pasture the following summer told on their summer growth, and they finished the year with gains costing $3.46 per hundred compared with $3.14 for those which had received three pounds each, and $3.17 for those which had received no grain, hay being worth at the time $6 per ton and grain $1 per hundred pounds. No doubt the "no grain" calves consumed more grass, which was not accounted for in the experiment, but which would have made the results still more in favor of a light grain ration rather than no grain in winter. Cured grass is not the equal of fresh grass, and a little grain with it is an advantage; but care should be taken that not enough grain be supplied to make the winter ration superior to grass alone which is to follow it.

As to the character of the ration, it may be said that if the roughage is in large part alfalfa, clover or cowpea hay, the small grain ration may consist of corn alone; but if roughage other than these legumes is fed, then the corn should be supplemented with an equal weight of bran, or one-third to one-half of that weight of oil-meal. Well-bedded barns or sheds closed on all sides, but with windows and doors always open and with a well-drained yard adjoining, will give the most approved quarters for wintering such calves.

After a summer of pasture, they may be fed, while yet on grass, fodder corn which has been planted rather thick to make the ears smaller in size and easier for yearlings to masticate. When placed in the yards, this same fodder corn may be fed in racks in the morning, the remaining half of the full feed to be supplied as shelled corn fed in open bunks during late afternoon, with a liberal feed of alfalfa, clover, or cowpea hay given at the same time of day. With any rough feed other than these legumes, as sorghum or millet, the grain fed at night should be one-fifth to one-fourth oil-meal, gluten or cottonseed meal. In other words, if these yearlings, when once on a full grain feed which has been brought about by a gradual increase during a period of four to six weeks, are each consuming per day eight pounds of corn on the stalk and eight pounds of grain at night, one and one-half to two pounds of that grain should be oil-meal, gluten meal or cottonseed meal, and the remainder shelled corn. It is assumed that there is one pig for each steer, to consume corn in the droppings. Feeding in this manner throughout the winter will put the cattle in good finish by spring, when they should weigh 1,100 to 1,200 pounds at twenty-three months and will command a good price.

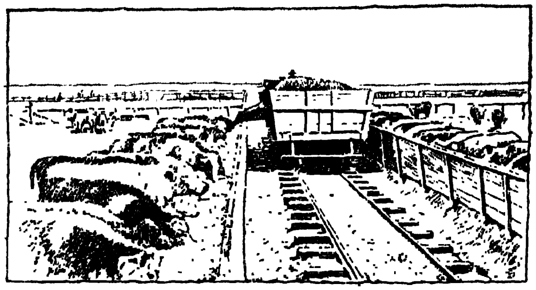

Fig. 345. Feeding beef calves, showing feed-pens and mule-drawn car. S. M. S. ranch, Stamford, Texas.

Short two-year-olds.

Finishing short two-year-olds by feeding grain in connection with spring and summer pasture accomplishes a still greater saving of grain than the method just described, because, with this system, a light grain ration is fed the first winter and something less than a half feed of grain the second winter. When corn is high in price and hay and grass are abundant, this method is very satisfactory. By it one takes advantage of the fact that a full feed of grain on grass is not more than

two-thirds of a full feed with hay; and even larger gains are to be expected when full-fed on grass. Here again we are confronted with the fact that fresh grass will go farther in beef production than will dried grass in winter. Soaked shelled corn seems to be most effective for spring and summer feeding, and nothing else is needed unless the grass is timothy or prairie, when additional protein should be supplied by the use of coarsely ground oil-cake or some other protein food. Summer-fed cattle should be marketed in July. Cattle would better be kept from grass entirely if an earlier market is sought, because the first few weeks on grass produces a shrink. On the other hand, cattle should not be held much later than July, because of the hot weather and flies.

Fall-feeding two-year-olds.

Fall-feeding two-year-olds with corn fodder (corn on the stalk) on pasture is a most excellent practice on farms situated for it. Corn may be fed as soon as it is sufficiently ripe to go in the shock; in other words, after the ears harden and the husk turns brown, yet while many of the stalk leaves are green. Immature corn should not be cut and fed to fattening cattle because it invariably causes shrinkage at the start, due, no doubt, to its laxative character. In an average season, the feeding of corn fodder may begin about September 15 and be continued in the field for a period of three months, at the end of which time two-year-old steers on good pasture will be sufficiently fat to market. The method has several advantages: (1) Corn fodder furnishes a cheap but effective combination of grain and roughage, lower in price than either fed separately. (2) It can be hauled from the shock and scattered on the sod or on ground which is to be plowed in the spring at a low cost for labor. (3) The manure is scattered in the fields without additional expense. (4) The feeding is done at a season when the weather is most favorable.

In feeding corn fodder, it is well to supply a quantity which will furnish each steer about three pounds of corn the first day. If the fodder is in bundles, this can easily be estimated and the material increased gradually until at the end of four weeks the cattle are receiving all the corn they will consume. When on a full feed of corn, there will be a considerable waste of stalks, much of which can be avoided by feeding some husked, snapped, or shelled corn in addition. A mixture of three pounds of bran and one pound of oil-meal or cottonseed meal, supplied to each steer per day, will increase gains materially, and will thus bring the cattle to an earlier finish.

Winter-feeding range two-year-olds.

Winter-feeding range two-year-olds or farm-grown cattle which have had no grain during summer and fall is the method most commonly practiced in the West, where corn is left standing in the field usually until November. Not many range cattle reach the markets until late in October or November, and the fattening period frequently extends to May. Snapped corn (ear within the husk) is most in favor during the early part of the feeding, and this with alfalfa or clover gives excellent results. Recent tests, however, have shown that the use of field-cured stalks with alfalfa gives just as large gains and at less expense. In fact, the most profitable rations of all those tested at the Nebraska Experiment Station during a period of four years were combinations of corn, alfalfa, and corn-stover (stalks), with the ration containing corn attached to the stalk (corn fodder) slightly in the lead of other rations containing the same foods. After cattle have been fed snapped corn for six or eight weeks, it is well to begin gradually with shelled corn, the same to replace entirely or in large part the snapped corn at the end of another month. If snapped corn is suddenly discontinued and shelled corn substituted, cattle will immediately "scour," and shrink in consequence. A little snapped, or, preferably, crushed snapped corn fed with shelled corn to the very close of the period insures better digestion and lessens the danger of founder, because the presence of the cob and husk makes the heavy grain ration less compact in the stomach. A little corn-and-cob meal will serve the same purpose. If, however, all the corn is fed as corn-and-cob meal, the extra gains made will not be great enough to compensate for the charge regularly allowed for grinding corn to the usual degree of fineness. Grinding might pay in the East, where corn is higher in price and the cost of labor on a par, but it will not pay in the West, unless hogs for consuming waste corn are not available, and frequently not even then.

Alfalfa, clover, or cowpea hay are more profitable than some other forms of roughage which require a supplementary protein food in addition. With these leguminous hay plants we are able to secure good gains by using nothing but corn as grain. But, without the legumes, it has been shown conclusively that the use of bran, oil-meal, gluten meal, or cottonseed meal as foods supplementary to corn, will not only make larger gains, but will also make them more profitably unless these protein foods are much above average prices. Two pounds of one of these concentrated foods per day to each animal is quite enough, increasing this quantity slightly if low in price or if corn is high, and diminishing it if the commercial foods are high and corn is low. Two-year-olds on full feed will take 20 to 25 pounds of grain per day, but less if deprived of the necessary protein food, which no doubt partly accounts for smaller gains made when thus fed. All the roughage that will be eaten should be supplied. This need not be weighed, but will amount to 5 to 10 pounds per day to each animal when on a full grain feed.

Range three-year-olds.

Range three-year-olds, weighing as feeders 1,100 pounds or thereabouts, are preferred by some farmers, because they take on fat faster and can thus be marketed that much earlier. While cattle of this age require more food for a given gain, that item may be offset by the fact that the same advance in selling price over cost price on older

Plate IX. Types of dairy cattle.—Holstein above, Ayrshire below

cattle will yield an increased profit, due to the larger initial weight of the older animals. In other words, $1.50 advance on a 1,100-pound feeder means $16.50 to start with, compared with $12.00 on the 800-pound feeder. Range three-year-olds seem to require a somewhat smaller proportion of the protein foods, but, on the other hand, they consume a larger proportion of grain to hay. Whether it is best to purchase range two-year-olds or three-year-olds depends entirely on relative prices and conditions existing on the farm of the prospective buyer. There seems to be a growing tendency to favor the younger cattle.

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Determining the Age of Cattle.

By *H. H. Wing.*

The teeth of the ox serve to help in the determination of its age, although not so accurately nor to so great an extent as in the horse. Under ordinary circumstances, the incisors are the only teeth that are used in the determination of age. Of these, the ox has eight, or four pairs, and on the lower jaw only. There are two sets, the temporary or milk teeth, and the permanent teeth, the latter differing from the former mainly in their greater size and width.

The calf is born with the two central pairs of milk teeth fully up, and the remaining pairs appear within the first month after birth. When the animal reaches the age of about eighteen months, the middle pair of milk teeth are replaced by permanent ones that are fully twice as broad as the milk teeth. The interval between the appearance of the succeeding pairs is rather variable, depending on the precocity or early maturity of the individual and also on the breed and the way in which the animal has been kept. Young cattle that have been ill-kept, and whose general development has been delayed, will have their dentition delayed, and will show a young mouth for their age. The interval between the appearance of each two pairs of teeth is seldom less than nine months, so that the age of the animal at the time each pair is up and in full wear may be reckoned as follows:

First, or middle pair	18 months
Second, or first intermediate pair . .	27 months
Third, or second intermediate pair .	36 months
Fourth, or outer pair	45 months

If there is any variation from the above, the animal is likely to be older rather than younger than the teeth indicate. After the teeth are up and in full wear, there is comparatively little change in their appearance for several years. The teeth are broad, flat and white in color, and their edges should almost or quite meet. They are never firmly fixed in the jaw, as in the case of the horse, but rather loosely imbedded in a thick cartilaginous pad or gums. The looseness of the teeth should not therefore be taken by the novice as an indication of unsoundness or of advancing age.

After the animal has reached an age of eight or nine years, the teeth becomes narrower through wear. They shrink away from each other and often become more or less discolored and finally drop out one by one. A vigorous old cow will often do very well, especially if fed liberally on grain and succulent food, after the last incisor tooth has disappeared. And so long as the teeth are all present and reasonably close together, the animal is said to have a good mouth. This condition may remain up to ten or twelve years of age, and occasionally even longer.

The horns also afford a means for estimating the age of cattle, especially of cows. During the first two years, the horns grow rapidly and the greater part of the total growth is made in this time. Afterward, the growth is slow from year to year, and each year's growth is marked by a more or less distinct ring. The first ring appears when the animal is about three years old, and the age may be reckoned by adding two to the number of rings present.

Common Ailments of Cattle. Figs. 346–359.

By *John R. Mohler* and *George H. Hart.*

Most serious ailments of live-stock should receive the attention of a skilled veterinarian. Failure to observe all conditions and directions carefully may result fatally, whereas a skilled veterinarian would have saved the animal. Frequently, however, it may be impossible to secure the veterinarian just when needed, and it is well for the farmer to know what to do in the emergency. Then, there are many ailments that can be treated by a careful farmer. It is the purpose of this discussion to give brief practical information for such cases. [The infectious diseases of animals are discussed at length by V. A. Moore, on pages 124–146.]

Before discussing some of the common ailments and diseases that affect cattle, it may be well to mention the various methods of administering medicines to live-stock and to compare the common means of measuring medicines, with their values in the apothecary system.

Methods of administering medicines.

Medicines are usually given by the mouth, although at times other methods, as per rectum, intravenously (into a vein), or subcutaneously (under the skin), are more certain, and in some cases must of necessity be employed. Medicines may also be applied externally by massage. They are given in the form of fluid, powder, pill, ball,

drench and paste. When given intravenously or subcutaneously, they must be in fluid form and be given with a hypodermic syringe. (Fig. 346.) Solids are sometimes, although rarely, given by the rectum.

Pills are small quantities of medicine rolled into a solid spherical mass. They have limited use for the domestic animals aside from the dog and cat.

Balls are larger masses of drugs, given principally to the horse. They should be spherical, soft in consistency and covered with oil before

Fig. 346. The use of the hypodermic syringe in vaccinating.

they are administered. After administering, a drink of water should be offered. The giving of a ball requires some skill, and is successful only after considerable experience. The ball should be held in the right hand between the thumb and first three fingers. The tongue is drawn out from the side of the mouth with the left hand, and the mouth kept wide open by pressing against its roof with the left thumb. The right hand, holding the ball, is passed back between the molar teeth as far as possible. Then, with a sudden thrust back into the throat, the ball is deposited, the hand withdrawn and the tongue immediately released so that when the animal draws the tongue back into the mouth the base of the organ will push the ball back into the throat far enough to prevent its being brought back into the mouth and chewed up, as so often follows the attempts of beginners.

Pastes or *electuaries* are soft, semi-solid masses of medicine mixed up with honey or molasses and spread over the tongue and teeth, with the idea that they will be slowly dissolved and swallowed. They are principally used in inflammations of the throat (laryngitis and pharyngitis).

Drenches are large quantities of fluid medicines given at one time, as of oil and salts. In administering a drench to the horse, the head should be raised until the face and nose are horizontal, and be held in place by means of a rope passed through or tied around the nose piece of the halter and run over an overhead beam, with an assistant holding the free end. The drench should be in a fairly long-necked bottle. When the animal's head is in position, the neck of the bottle is passed into the mouth at the corner of the lips and the drench slowly poured on the upper surface of the tongue as far back in the mouth as possible. In case the animal coughs or shows signs of discomfort, the head should be lowered slightly by loosening the rope until relief is obtained, when it may be drawn up again. In cattle, drenches may easily be given by grasping the nostrils with one hand and holding the head up while the other hand manipulates the bottle containing the medicine. In the dog, it is well to draw out the side of the cheek, leaving the teeth closed, and pour the medicine slowly into the cavity thus formed. In all drenching, taking plenty of time is the keynote of success.

Common means of measuring medicines, with their values in the apothecary system.

Teaspoon contains about 1 dram ($\frac{1}{8}$ oz.)
Dessertspoon contains about 2 drams ($\frac{1}{4}$ oz.)
Tablespoon contains about 4 drams ($\frac{1}{2}$ oz.)
Heaping tablespoon of powder contains about 1 ounce.
Tea-cup holds about 5 ounces.

Wounds and their treatment.

A wound is an injury to any part of the body, causing disruption of the affected parts with or without laceration of the skin, and produced by external violence. According to the method of production we have incised, punctured, contused, lacerated and gun-shot wounds.

The first object to be sought in all serious wounds is the checking of the flow of blood. This may be accomplished by several methods, such as compresses, bandages, torsion, hot iron and ligatures. The heat from the hot iron, which should be used at a red heat, will cause the immediate clotting of the blood in the vessels, which is further supported by the production of a firm scab. The hot iron should be used with care and applied only to the bleeding points. Cold water and ice-bags quickly stop small hemorrhages when the blood oozes from the cut surfaces. Some drugs, called styptics, possess the power of contracting the blood-vessel walls and also of clotting the blood. As examples of such drugs may be mentioned chlorid of iron, tannic acid, alcohol and oil of turpentine. A pure solution of the tincture of the chlorid of iron placed directly on a wound or applied by saturating cotton will produce a rapid and hard clot. It is followed by a great deal of sloughing (casting off of tissue) and therefore should be sparingly used over large surfaces. To check bleeding from large vessels, compression must be adopted. When rapid and dangerous and from an artery (coming in spurts), the finger may be used for pressing on the vessel between the wound and the heart; but if from a vein (flowing regularly) the pressure should be exerted on the other side of the wound, away from the heart. Compression may also be used by passing a strap around the part and tightening, after placing a raised pad over the point of hemorrhage. Tam-

pons of cotton, tow or oakum may be packed tightly into a wound and held in place by bandages for twenty-four to forty-eight hours.

Ligation, when practicable, is an exceedingly successful method of stopping hemorrhage. It consists in grasping the bleeding vessel with the forceps and tying a clean cord or string tightly around it about one-half inch from the end, using all the antiseptic precautions given below. If the vessel cannot be picked up alone it may be necessary to pass the thread around a mass of tissue, including the bleeding vessel, to arrest the blood flow.

Medicinal treatment of wounds.—Whenever an animal in a public place receives a wound, there is usually some one present who has a remedy of wonderful curative power for just that condition. Many of these quack mixtures are harmful. Among these injurious agents may be mentioned cobwebs, wood ashes, tobacco, horse manure and various preparations of alcohol, turpentine, irritating oils, and in some cases the direct application of pure spirits of salts (hydrochloric acid) or other of the mineral acids.

Every wound, after the hemorrhage has been arrested, should have the hair in the immediate vicinity of the edges trimmed away and all foreign bodies and dirt particles carefully removed with clean fingers or forceps. It should then be washed with some antiseptic solution, as 5 per cent carbolic acid or lysol, or $\frac{1}{1000}$ bichlorid of mercury applied with a sponge or syringe. When necessary, the edges of the wound should be sewed together, following which, in fresh, uncomplicated wounds, a drying astringent antiseptic powder, as tannic acid, boric acid or iodoform, may be dusted over it. However, when it is badly lacerated and is befouled with dirt, as a kick wound, or when it is old and bacteria have gained entrance, producing suppuration and the discharge of pus, it will be better to leave the wound open and treat it with antiseptic solutions or by continuous irrigation until the discharge of pus ceases, when the drying astringent powders may be applied. [For Wound infections, see page 125.]

Mammitis (Mastitis), garget or caked-bag.

Mammitis is an inflammation of the udder appearing in two forms, simple and infectious. The simple form is really an infection, generally entering through the milk canals, but ordinarily it does not spread from one animal to another. This form, which alone will be discussed in this article, usually occurs right after calving and may involve part or all of the udder. (Fig. 347.) As causes of simple mammitis may be mentioned lying on damp floors, great distention of the udder during the latter part of pregnancy, rough milking, nursing of large calves, irregular milking, or congestion of the udder from internal causes. [Infectious Mastitis, pages 125, 126.]

The symptoms of the non-infectious form are as follows: One quarter, a side or even all four quarters become enlarged and firm. It may start with only a small area, and gradually spread until a whole quarter or the entire udder is infected. The animals are depressed and there may be a slight rise of body temperature. The local temperature of the udder is always increased and the gland is sensitive to pressure. The flow of milk is lessened, and what milk is secreted is watery and may contain pus cells or be tinged with blood.

Treatment.—Give sparingly of milk-producing foods, as activity of the udder is to be avoided. The udder should be well massaged with the hand, and camphorated oil or tincture of iodine one part, alcohol eight parts, applied and rubbed in well. Then very severe warmth should be applied by means of sponges wrung out of hot water and held against the udder until cool. In case abscess formation is threatened, bean or flaxseed poultices may be applied until good fluctuation is present, when the abscess should be opened and the pus allowed to escape. If gangrene develops, strong antiseptics, as 5 per cent carbolic acid or $\frac{1}{1000}$ bichlorid of mercury, should be applied externally. Injections of antiseptics into the udder through the teat ducts is indicated in aggravated cases. Among the best solutions for this purpose may be mentioned ½ per cent carbolic acid or lysol, 4 per cent boric acid, or

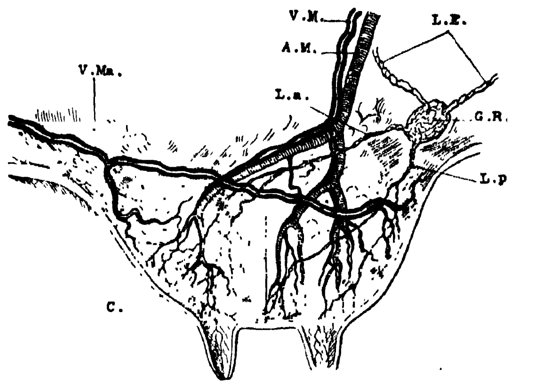

Fig. 347. Section of cow's udder. *G. R. M.*, lymph gland of udder; *L. p.*, lymphatics of hind-quarter; *L. a.*, lymphatics of fore-quarter; *L. E.*, lymphatics leaving the udder; *A. M.*, mammary artery; *V. M.*, mammary vein; *V. Ma.*, anterior mammary vein; *C.*, transverse intermammary septum. (After Moussu.)

.5 per cent permanganate of potash. Before the injections are made, however, the external surface of the udder should be thoroughly cleaned and the syringe used for the injection should be boiled.

Chapped teats.

This affection is common among cattle during the period of lactation, and may cause great difficulty in milking. One of the commonest causes is the sucking and biting of a several-weeks-old calf; also turning a cow out in a cold wind while the teats are still wet from the calf sucking, or from milking with a wet hand. Lying down in the stable with the teats coming in contact with manure or urine may likewise be a cause. The animal will not stand quietly to be milked, and may kick.

Treatment.—In fresh cows, the calf should be weaned as soon as possible. Care should be taken

to see that the teats are dry before turning the animal out of the stable in wet weather. Bland antiseptic ointment, as a 10 per cent ointment of calomel in petrolatum, should be applied after milking. Yellow oxid of mercury in a 5 per cent ointment is also good. Care must be exercised to prevent the milk becoming contaminated with these ointments. In very bad cases, the milk should be withdrawn for a few milkings with the milking-tube, accompanied by massage of the udder. It is imperative that the end of the teat be disinfected and the milking-tube sterilized before it is inserted. Astringent applications, as lead water with laudanum or tannic acid ointment, are good when there is considerable discharge from the sores.

Milk-fever.

This is a serious disorder affecting well-nourished, fat, heavy-milking animals at the most active period of life, and is characterized by sudden onslaught, complete paralysis of the animal with the loss of sensation, and by following closely on the act of calving and terminating rapidly in recovery or death. The principal predisposing causes are great activity of the udder, and a plethoric condition (excess of nutrition in blood-vessels and organs) of the body resulting from excessive feeding and lack of exercise before calving. As to the direct cause of the disease, various theories have been advanced, the most generally accepted of which is, that it is a poisoning of the body due to the absorption of toxic substances from the udder. This theory was considered to have settled the discussion, until within the last two years, when good results were secured by the injection of ordinary atmospheric air, since which time the exact cause of the disease has been in doubt.

The attack usually comes on within two days after calving. The animal is restless, treads with the hind feet, switches the tail, stares anxiously around the stall or walks about uneasily. These symptoms are rarely recognized by the owner, but are rapidly followed by beginning paralysis, noticed by a staggering gait, especially in the hind-legs, and weakening of the knees and fetlocks in front. This increases until the animal goes down and is no longer able to rise. The paralysis becomes general, the calf is unnoticed, and the cow lies perfectly quiet and insensible, not even winking when the finger is placed on the eyeball. While down, a very characteristic position is assumed, which is of great aid in diagnosis. The head is turned around to the side, usually to the left, and it rests against the chest, causing a peculiar arching of the neck. (Fig. 348.) If the head is drawn out straight, it immediately flops around to the side again on being released. There is paralysis of the muscles of the throat, so that swallowing is difficult.

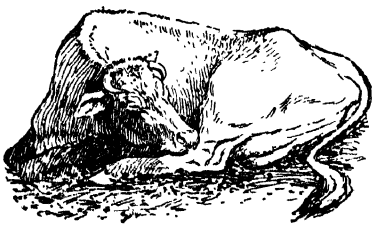

Fig. 348. Cow with milk-fever, showing characteristic position.

Treatment.—Because of the paralysis of the throat, great care should be taken in the administration of medicines by the mouth, as they are likely to pass into the wind-pipe, and set up traumatic pneumonia, which is invariably followed by death. The patient should be kept in the upright position on the breast-bone, and not on her side. Bags of chaff or straw may be used to keep her propped up. The feeble pulse calls for the administration of stimulants, such as subcutaneous injections of strychnine sulfate, one grain three times daily. Although this treatment will assist in curing the patient, it is merely accessory, and can be of very little value without the injection into the udder of atmospheric air. The application of this treatment requires the use of an apparatus such as is shown in Fig. 349. The metal cylinder is filled with dry cotton, which filters the air as it passes through. The udder should be thoroughly cleansed and washed with a 5 per cent solution of carbolic acid. The entire instrument should be boiled before using, the water forced out of it, and protected from dirt, so as not to contaminate the milk ducts and cause garget. Fresh clean dry cotton must be inserted in the metal chamber before each using, and it must be kept clean and dry. After the udder is cleaned, the milking-tube is inserted into the four teats in succession, the rubber bulbs are squeezed, and the air, sterilized by filtration through the dry cotton in the metal chamber, is forced into the udder until the latter is well distended and tense. After the milking-tube is withdrawn, the teats should be tied with broad tapes to prevent the escape of the air. In case the air becomes absorbed and no improvement is noticed within five hours, a repetition of the injection should be made, using the same antiseptic precautions as at first. The tapes should not be kept in place too long, as they may cause swelling of the teats from shutting off the blood supply. Since the adoption of this method of treatment, the death rate has been reduced to about 3 per cent as against a mortality of 40 per cent. (Adapted from Farmers' Bult. No. 205.)

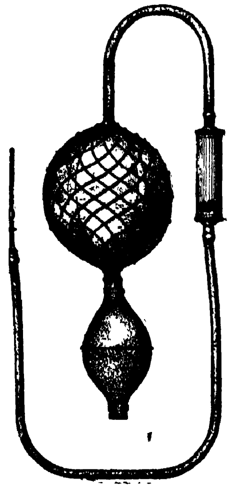

Fig. 349. Apparatus for injecting air into the udder. A dangerous instrument in the hands of the careless.

Retained afterbirth.

This is a common ailment on all cattle-breeding and dairy-farms. It may result from several causes, chief of which may be mentioned abortion, in which case the normal fatty change which loosens the placenta at the end of pregnancy has not occurred.

CATTLE

Debility of the animal may be a cause, all the muscular strength of the uterus having been expended in expelling the fœtus. Too rapid closure of the uterine neck may imprison the yet undischarged membranes in the womb.

The symptoms are very obvious. The membranes are usually seen protruding from the vulva. Their blood supply being cut off, they rapidly undergo decomposition, become very foul and scent the entire building. The animal usually continues to strain, does not eat well, and does not come up to her normal flow of milk. The absorption of the decomposing substances by the uterine walls causes a slight rise of temperature.

Treatment.—This has for its object the removal of the membranes, when the other symptoms will subside. A reasonable time should be allowed after the birth of the calf for the animal to expel the membranes unassisted, during which time one or two one-half-ounce doses of fluid extract of ergot may be given. In no case, however, should manual assistance be withheld longer than twenty-four hours. Manual removal may sometimes be accomplished by wrapping the extruded membranes around two sticks and producing gradual traction, and wrapping the loosened part until finally it all comes out. When the membrane has decomposed, it is very likely to tear when traction is made. In such case, other means is employed. This consists in passing the hand and arm up into the uterine cavity and pealing out each individual fetal placenta from the enclosing button (cotyledon). The most anterior ones may be out of reach, in which case slight traction on the membrane will draw the uterine walls within reach of the fingers. In undertaking this procedure, the arm should be bared to the shoulder and thoroughly washed in soap and water, followed by 3 to 5 per cent creolin solution. After the placenta and membranes are removed, if there is any fluid in the uterine cavity it may be removed by washing out the uterus with a 1 per cent creolin solution through a rubber tube.

Mycotic stomatitis (sore tongue). [See page 139.]

This is an inflammation of the lining membrane of the mouth, which quickly develops into ulcers. It is caused by eating forage containing irritant fungi or molds. Other names that have been applied to this disease are sporadic aphthæ, and non-infectious foot-and-mouth disease. Among the first symptoms observed are inability to eat, frequent movements of the lips with the formation of froth on their margins, and in some cases a dribbling of saliva from the mouth. There is a desire to eat, and frequent attempts to take food are made, but the mouth is so sore that eating is very difficult. The ulcers are found most frequently on the gums around the teeth, inside the lips and on the tip of the tongue. The muzzle becomes dry and parched, and crusts and scabs form over the parts, which peel off. The thin skin in the clefts between the claws may become fissured and eroded, causing a slight swelling with pain. As a result of these feet lesions, the animal may assume a position with its back arched and the limbs propped under the body, and will manifest considerable lameness in walking. (Fig. 350.) A similar tendency toward the formation of fissures and scabs on the skin of the neck, shoulder, and udder has been observed in some instances. Owing to the inability to eat, the animal loses flesh very rapidly and becomes greatly emaciated in the later stages of the disease.

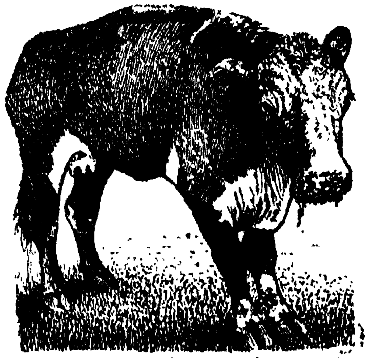

Fig. 350. Cow with mycotic stomatitis.

Treatment. — The treatment of mycotic stomatitis should consist in first removing the herd of cattle from the pasture in which they have been running. If it is possible, the affected animals should be brought to the barn or corral and fed on soft, nutritious food, such as bran mashes, ground feed and gruels. A bucket of clear, cool water should be kept constantly in the manger, so that the animal may drink or rinse the mouth at its pleasure; and it will be found beneficial to dissolve two heaping tablespoonfuls of borax or one tablespoonful of potassium chlorate in each of the first two buckets of water taken during the day. Astringents, such as one-half tablespoonful of alum, borax or chlorate of potash should be placed on the tongue. The lesions of the feet may be treated with a 2 per cent solution of carbolic acid or of creolin, while the fissures and other lesions of the skin will be benefited by the application of carbolized vaseline or zinc ointment. (Bureau of Animal Industry, Circular No. 51.)

Indigestion, or acute gastro-intestinal catarrh.

This is an acute catarrhal inflammation of the lining membrane of the stomach and intestines. Debility from any cause predisposes to this disorder. In all acute febrile diseases there is a mild catarrh of the digestive tract. As causes of the more severe forms of this disorder may be mentioned irregularities of diet, as eating frozen food or decomposing food, over-eating, or changing suddenly from dry to green foods. Drinking large quantities of ice-cold water, as seen in stabled animals in the winter season when they are turned out once daily to drink from a running stream or trough, is another cause. Sometimes it is seen in cows that have eaten their afterbirth, which undergoes decomposition in the stomach.

The symptoms will depend on the part of the gastro-intestinal tract which is the seat of the disease. When the stomach and small intestine are affected, there is usually loss of appetite and rumination, coated tongue and emaciation. Constipation is usual, although diarrhea may be present. If the fecal matter is examined, it will usually be found to contain particles of imperfectly digested food, and more or less mucus, which is intimately

mixed with the feces. When the large intestine is involved, the appetite may not be affected. Diarrhea is marked, and the droppings are covered with a coating of mucus. No undigested food will be present, as digestion is mainly completed by the time the food reaches the large intestine. The entire intestinal tract may be simultaneously affected, however, and the animal will rapidly lose flesh and become hidebound with a starry coat. The condition may become more marked and pass into a gastro-enteritis and result fatally. On the other hand, it may remain stationary and merge into a chronic catarrh, or, as in the majority of cases which receive proper care, it may end in recovery.

Treatment.—For this to be successful, it is necessary to remove the cause. If constipation is present, or there is irritating ingesta in the digestive tract, a non-irritating purgative, as one quart of castor-oil, should be given. The food should be given in small quantities, and should be easily digestible and nutritious. Green food is preferable in such cases when it can be had. If not at hand, hot bran mashes are advisable for a few days, with very small amounts of good sweet hay. When there is diarrhea and fermentation, a mixture of bismuth subnitrate one dram, and creosote one-half dram, shaken up with milk and given as a drench twice daily for two or three days, will prove beneficial. After the acute attack is over, if the animal is run-down and emaciated, a tonic powder consisting of powdered nux vomica one dram, reduced iron one-half dram, powdered gentian root one ounce, should be given in the feed two or three times daily for a few weeks.

Hoven, bloating or gaseous distention of the paunch.

This is a suddenly developing disorder of cattle, caused by dietetic irregularities and characterized by over-distention of the paunch with gases of fermentation. The causes are more or less varied. The most common is probably the turning of cattle into young green pastures, especially clover, in the spring after they have become accustomed to solid dry stable food. These pastures are more dangerous if they are covered with frost or a heavy dew. Frozen foods or foods that have been frozen, and decomposed foods, are also likely to produce the disorder. Ravenous ingestion of large quantities of unusual foods may be a cause, as seen in animals that break into feed rooms containing corn meal, potatoes, or into fields containing young growing corn or other grains. The onset is often explosive in character, and the owner's attention is first called to the disorder by seeing one or more of the animals dropping dead in the field. In such cases, death is due to a combination of shock, asphyxia and congestion of the brain. In the less severe cases the animal is seen to be restless, stops eating and ruminating and shows evidence of great distress. The abdomen is greatly distended, especially on the left side, and the left hollow of the flank is obliterated by the distended rumen. Breathing is greatly embarrassed. The anus bulges out, but constipation is usually present. On tapping the left flank lightly with the closed fist a sensation similar to that produced by striking a drum is imparted to the hand. The right side may also be distended, and when this occurs there is danger of the animal dropping at any moment. They usually remain standing until the last, drop suddenly and die in a few minutes.

Treatment.—This must be prompt, and in severe cases the first procedure is to remove the gas which is mechanically causing the symptoms. This is done by plunging a trocar into the left flank at a point equidistant from the haunch, last rib and transverse process of the lumbar vertebræ. The stilet is then withdrawn, leaving the hollow canula in place through which the gas escapes. In less severe cases, or when a trocar is not at hand, dashing cold water over the abdomen or brisk massage of the left flank may be tried. Placing a rope or piece of wood through the mouth and securing it there by tieing it around the head, will cause the animal to masticate, churn up the saliva and excite swallowing, which tends to open the esophagus and allow the gas to escape in this manner. Passing a probang into the stomach is also successful and less dangerous than puncturing the flank in moderately severe cases. When the most distressing symptoms are relieved, drugs to prevent fermentation are indicated, as creosote, two or three teaspoonfuls in a pint of milk, or hyposulfite of soda in one ounce doses in water.

Choking.

From their normal habit of swallowing food with little mastication, cattle are particularly liable to this trouble if they have access to whole apples, turnips, potatoes and like foods. Foreign bodies picked up and swallowed during eating of food are also causes of choking. The mass may lodge in the pharynx, or in the cervical or thoracic parts of the esophagus.

If the obstruction is in the pharynx there may be considerable obstruction to breathing, while if in the cervical part of the esophagus a tumor may be seen and palpated on the left side of the neck. If within the esophagus in either the cervical or thoracic parts, there is likely to be distention of the rumen, because gases formed there are unable to escape. Other symptoms more or less constant, no matter at what point the body lodges, are champing of the jaws, dribbling of saliva, ceasing to chew the "cud," wretching or choking movements, head extended, eyes bulging, and inability to swallow; if the body is in the thoracic part of the tube, a few mouthfuls of food may be swallowed, but it is soon returned through the mouth and nostrils.

Treatment.—When the offending substance is in the pharynx, a block of wood should be placed in the mouth between the back teeth of the animal to keep the mouth open, and by passing the hand back into the pharynx the foreign body can usually be grasped and removed. If in the gullet, however, this is impossible. In such cases a small amount of olive-oil should be given at frequent intervals, which may lubricate the esophagus sufficiently for the foreign body to pass into the stomach by the animal's own efforts. If this fails, the probang,

which is a long, hollow, flexible tube, or some makeshift, as a carriage whip, may be used. It is oiled and the mouth is opened by a wooden speculum or block containing a small round hole in the center, through which the probang is passed into the esophagus until it strikes the foreign body. By gentle manipulation and pressure the body is then gradually forced into the stomach.

Cough (bronchitis), or acute bronchial catarrh.

This is an ailment of cattle resulting from exposure and debility, characterized by an inflammation of the mucous membrane lining the bronchial tubes, and accompanied with fever and cough. Predisposing causes are confinement in poorly ventilated damp or dark stables, poor quality or insufficient quantity of food, previous attacks of bronchitis, and the presence of other diseases. The principal exciting cause is exposure to cold, as lying on cold ground, drafts of air, or being out in a storm over night.

The disease is ushered in with chilly sensations or a distinct chill. This is followed by a rise of temperature to 103° to 105° Fahr., impairment or loss of appetite and rumination, dry muzzle, constipation, increased rapidity of pulse and respiration. The cough is a very marked and important symptom. It is at first dry, harsh and painful; later, when the catarrhal exudate is poured out on the inflamed mucous membrane covering the bronchial tubes, the cough becomes moist, and there is usually a nasal discharge. Physical signs are present on examination of the chest, but require an experienced ear to be recognized and interpreted. In ordinary cases recovery occurs in four to nine days. In neglected cases the inflammation extends down into the air-cells, giving rise to a pneumonia; or the acute bronchitis may gradually merge into the chronic form of the disease, and the cough be continued for several months or even longer.

Treatment.—The animal should be placed in a large, comfortable, light stall, preferably a box-stall. It should have plenty of clear, cold water to drink. The bowels should be freely opened with one pound of Glauber's salts. The food should consist of green, succulent materials, when such can be had. In the winter season, bran mashes, and small quantities of hay, sprinkled with water to allay the dust, are valuable. Medicinally, an electuary (see page 322), consisting of extract of belladonna leaves five grains, morphine sulfate three grains, powdered licorice-root four drams, and sufficient simple syrup to make an electuary, should be given on the tongue four times daily. This will lessen the secretion and cough, and hasten the resolution of the process. If the cough persists after the secretion ceases, and remains hard and nonproductive, a mixture consisting of ammonium chlorid one dram, in one-half ounce of brown mixture, should be given four or five times daily.

Traumatic pericarditis.

This name is applied to foreign bodies in the heart sac, or injury to the heart by foreign bodies. It is a fatal ailment of cattle resulting from the swallowing of foreign bodies, which penetrate the stomach wall and pass through the diaphragm, finally puncturing the pericardium and even the heart muscle. Cattle are the only domestic animals, except possibly the goat, which are subject to this disorder. This is due to several factors. The mucous membrane lining the mouth cavity of the bovine species is very thick and not very sensitive. Cattle also take their food in large mouthfuls and swallow it with very little mastication. They sweep their food into the mouth with the prehensile tongue, which favors the picking up of foreign bodies. Once the foreign body gains entrance to the mouth, the large bolus of food, together with the slight mastication and insensitive mucous membrane, allows it to be swallowed without being noticed by the animal. The foreign bodies that have been found in the stomach of the ox comprise a great variety of substances, but pins, nails, pieces of wire, hair-pins, and other sharp pointed objects are the most serious.

In the early stages the symptoms are very indefinite. Later, however, the animal moves about carefully and will not turn around in a small circle. Sudden movement causes pain, as evidenced by a grunting sound. The back is arched, respiration and pulse are rapid, and rumination ceases. Constipation is present, and emptying the bowels is painful. Later, an edematous (dropsical) swelling

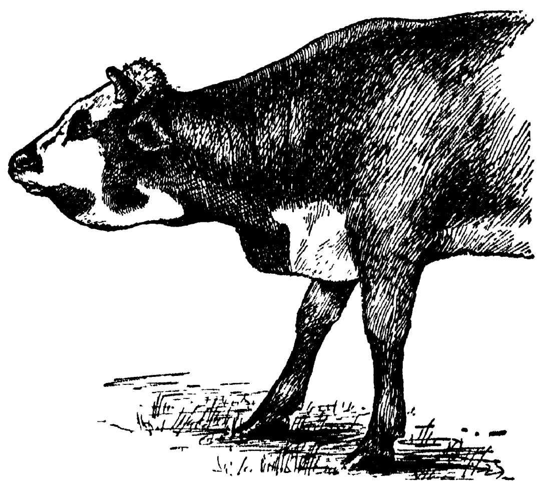

Fig. 351. Cow afflicted with fully developed pericarditis.

may appear under the jaws, between the fore-legs and in the dewlap. (Fig. 351.)

Treatment.—Drugs are useless. A very few cases have been cured by surgical treatment. As soon as the condition is ascertained the animal should be slaughtered before the pathological changes become so extensive as to prevent the flesh being used for food. In the preventive treatment, care should be used to prevent sharp-pointed metallic substances from getting into the feed or troughs of bovine animals.

Warts.

Warts are grayish or grayish-red projections of the skin or mucous membrane, resulting from the

excessive growth of localized areas of the tissue. These growths are also called "angle-berries" and may assume a variety of forms. (Fig. 352.) A

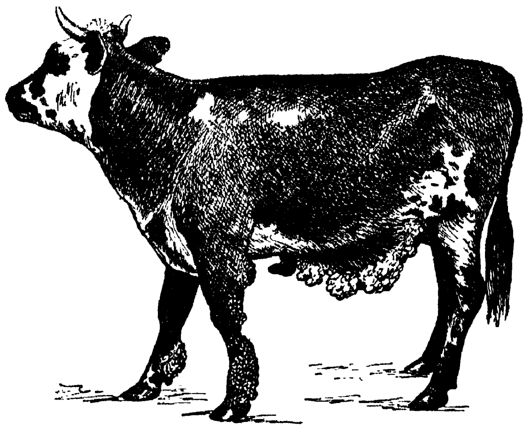

Fig. 352. Cow with an excessive number of warts.

favorite location for warts is the udder and teats, the sides of the head and neck, and on the legs and belly.

Treatment. — Warts may be removed with the scissors or twisted off with the fingers, or ligatured by means of a rubber band or horse hair. Their roots should then be cauterized with tincture of iron, glacial acetic acid or lunar caustic. Acids should never be used in removing warts about the eyes or in the mouth. In case warts are found in large numbers on an animal, arsenic in the form of Fowler's solution should be given in one teaspoonful doses twice a day for a six-months-old calf.

Mange.

This is a contagious skin disease that affects all domestic animals, and is caused by a small parasitic mite. Three forms, each caused by a specific mite, are distinguished, namely, sarcoptic, psoroptic, and symbiotic. Mange is most common in the dog and sheep, is fairly common in the horse and ox, and is but rarely seen in the cat and pig.

Mange is never developed except by contagion. The period of incubation (the period which elapses between the deposit of acari on the skin, and the appearance of skin alterations) varies from two to four or six weeks. Infection may take place by

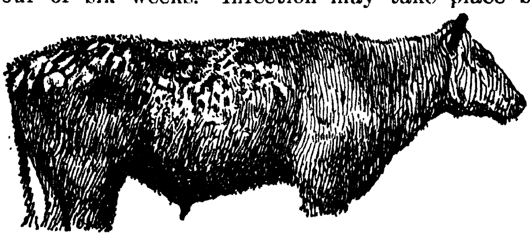

Fig. 353. Mange in an advanced stage

direct contact, or by intermediary agents, such as blankets, harness, bedding, and the like. Animals that have not received proper attention to the skin, or that are weak and emaciated, are particularly subject to mange. The first symptoms noticed are points of redness, pimples, vesicles, and formation of scabs. As soon as they appear, these lesions are accompanied by an intense itching, which becomes unbearable at night in hot stables, or during the day, when the animals are exposed to the hot sun. The animals scratch, rub, and bite themselves on the affected regions, the hair falls out, and the skin is bloody. When the disease reaches its height, we find the skin moist and bloody, ulcerated, scabby, thickened and wrinkled. (Fig. 353.)

As a rule, the course of the disease is chronic. While the symbiotes parasites remain stationed in a very limited area of the skin, the psoroptes and the scarcoptes often invade the whole surface of the body. The symptoms are always more intense in the summer. The diagnosis of mange may be made from the symptoms already mentioned, by its spreading from one animal to another in a stable or kennel, and by finding the parasite. This may be done by scraping some of the scab from a mange suspect and examining it under a magnifying glass.

Treatment.—Animals affected with mange never recover spontaneously. The only cure is in the use of drugs that will kill the parasites, and in their constant and regular application. Among such agents may be mentioned sulfate of soda, dilute ammonia, sulfur, and either 5 per cent solution of carbolic acid, or creolin. Various sulfur prepara-

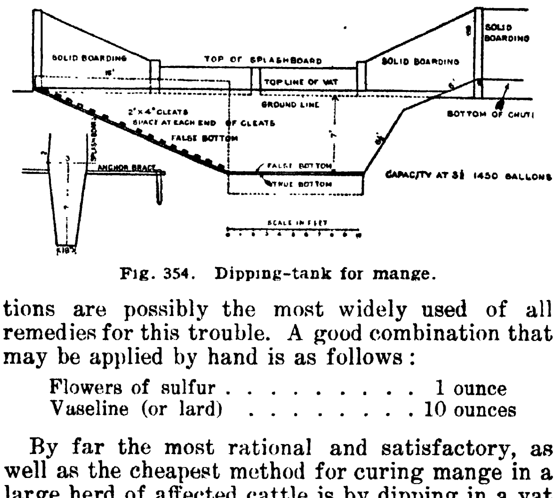

Fig. 354. Dipping-tank for mange.

tions are possibly the most widely used of all remedies for this trouble. A good combination that may be applied by hand is as follows:

Flowers of sulfur	1 ounce
Vaseline (or lard)	10 ounces

By far the most rational and satisfactory, as well as the cheapest method for curing mange in a large herd of affected cattle is by dipping in a vat containing the following fluid:

Flowers of sulfur	24 pounds
Unslaked lime	12 pounds
Water	100 gallons

Animals that have been exposed should be dipped as well as those that show evidences of the disease. After an interval of ten days, or two weeks, the animals should be subjected to a second dipping, in order that parasites hatched from the eggs left on the animals after the first treatment may be destroyed. A medium-sized vat with specifications is shown in Fig. 354, adapted from

Farmer's Bulletin No. 152, United States Department of Agriculture. A large dipping-vat is shown in Fig. 355.

Ring-worm.

Ring-worm is an affection of the skin due to a vegetable parasite. It affects the hair and the skin

Fig. 355. Large dipping-vat in use.

and is highly contagious, being readily transmitted from one animal to another. The disease becomes manifest by the formation of circular patches on the skin, which soon become denuded of hair. (Fig. 358.) The outer layer of skin is slightly inflamed and vesicles form which exude a gummy liquid. This is followed by the formation of scaly, brittle crusts. The patches appear silver-gray when encrusted. As a rule, these ring-worm patches appear mainly on the head and neck. The disease is most common on young cattle in the winter and spring. Very early in the development of the patches the hair becomes brittle, splits and breaks off close to the skin. This stage is attended with more or less itching. Ring-worm may be due to either of two vegetable parasites, and both forms may be transmitted to man.

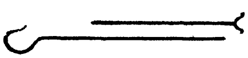

Fig. 356. Crook and crotch for use in cattle-dipping.

Treatment.—Remove all crusts by washing with soap and water, then apply acetic acid (vinegar), 10 per cent sulfur ointment, tincture of iodine, or nitrate of mercury ointment once daily. Cleanse the stable and whitewash it to destroy the spores scattered by the crusts.

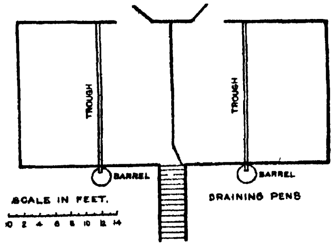

Fig. 357. Draining-pens for cattle after dipping.

Lice.

While these parasites do not cause any specific disease, they attack nearly all of our domestic animals and man. Their presence causes great discomfort to their host, and in most cases they cause some depreciation in the value of the animal on

which they make their home. They fix their eggs (nits) on the hair of the animal affected with them, and thus constantly reproduce new generations on the same host. (Fig. 359.) The horse, ox, pig, goat and dog are each affected with a distinct species, and only in rare instances is the louse peculiar to one species of animal found on any member of another species. In general, lice become easily and rapidly developed on poorly fed, weak and debilitated animals. Their presence is an indication of insufficient care of the skin. They produce itching, falling of the hair and desquamation of the outer layer of the skin.

Treatment.—Many lotions have been used against lice. Probably the easiest to prepare and the most successful is an infusion of tobacco stems, one pound of the stems to two gallons of water. Allow the stems to soak over night and then heat the mixture to the boiling point. Allow to cool and then apply with a sponge to the regions infested with the insects. Repeat the treatment in five or six days to destroy the nits that have been hatched and before they lay eggs.

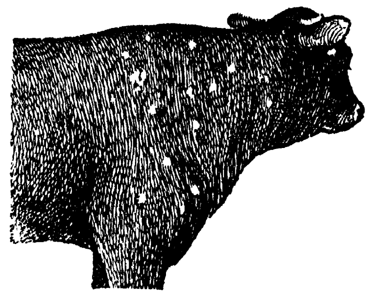

Fig. 358. Bull with ring-worm lesions.

Imaginary diseases.

It may be well to point out the error of herdsmen in the treatment of certain popular, although imaginary diseases of animals, which either do not really exist or are merely symptoms of some other disorder. Among these are hooks-in-the-eyes, hollow-horn, loss of cud and wolf-in-the-tail.

Hooks-in-the-eyes.—This is a condition in which the nictitans membrane protrudes from the inner

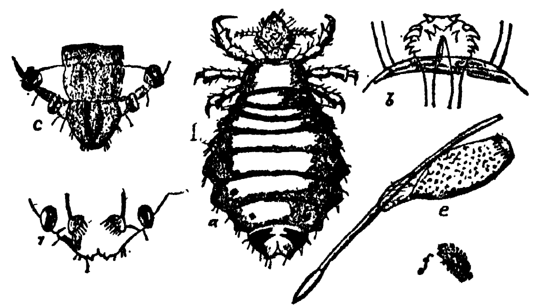

Fig. 359. Short-nosed ox louse. *A*, female; *b*, rostrum; *c*, ventral surface of the last segments of male; *d*, same of female; *e*, egg; *f*, surface of same greatly enlarged. (After Osborn.)

corner of the eye and appears as a reddish colored membrane partly covering the eyeball. This protrusion is due to congestion or a slight enlargement of the membrane. It is a common practice in some

localities to diagnose the condition "hooks-in-the-eyes," and immediately to cut or burn out the membrane, which is both unnecessary and barbarous. The condition requires no treatment, as it will never interfere with the health of the animal and will usually disappear of its own accord.

Hollow-horn is a term applied to numerous disorders in cattle of a varied character. A herdsman notices that his cow is not in perfect health and considers the condition a case of hollow-horn. He then proceeds to bore a hole in the horn and confirms his diagnosis by finding the horn hollow, and treats the condition by pouring into the horn core turpentine or some other irritant substance. It is a perfectly normal condition in cattle to find the horn hollow, as the examination of a healthy horn will prove, and the use of turpentine in these conditions is cruel and not of the slightest value.

Loss of cud. — In all severe febrile diseases of cattle, one of the most common symptoms is the stoppage of chewing the cud. It is therefore merely a symptom present in a great many diseases, and the administration of ham fat, lard, fish, and the like, has not the slightest value in restoring the cud. The animal should be carefully examined to find the actual abnormal condition or disease that causes the suspension of rumination, and then the treatment applied for the disease that exists.

Wolf-in-the-tail.—Almost any disease of cattle in different localities may be diagnosed "wolf-in-the-tail." An incision is made into the tail and salt is packed into the opening, which is supposed to have a curative effect. In case recovery occurs, the owner thinks the animal's life was saved by the treatment. In reality there is no such thing as "wolf-in-the-tail," and the disorder will always be found to have its seat elsewhere. What has been termed "wolf-in-the-tail" of cattle has been called "worm-in-the-tail" of dogs.

Literature.

There is considerable published information concerning the common ailments of cattle, some of which is referred to on pages 124–146. Reference is here made to the following: Special Report on Diseases of Cattle, Revised Edition, United States Department of Agriculture, Bureau of Animal Industry (1904); Moussu and Dollar, Diseases of Cattle, Sheep, Goats and Swine (1905); James Law, Textbook of Veterinary Medicine, five volumes (1903); Leblanc, Diseases of the Mammary Gland (1904); Friedberger and Frohner, Veterinary Pathology, Vol. II, translated by Captain Hayes (1905); Cadiot-Almy, Surgical Therapeutics of Domestic Animals, translated by Liautard (1906).

Aberdeen-Angus Cattle. Figs. 360, 361.

By *John S. Goodwin.*

The Aberdeen-Angus is a breed of cattle maintained primarily for beef-production. It is a hornless or muley type.

Description.

Aberdeen-Angus cattle are distinguished by the following breed characteristics: black color, polled heads, rotund compact type, smoothness of conformation, short legs, evenness of flesh when fat, and deep, full hind-quarters. They are uniform in type, take on flesh evenly, dress a large percentage of high-class beef, and as a rule, reach in the hands of experienced feeders a degree of primeness rarely equaled. The marbling of their flesh, i. e., its proportion and blending of lean meat and fat, is also a characteristic. In slaughter tests they have been uniformly successful in competition with other cattle, their fineness of bone and high percentage of muscle or lean meat giving them dressing scores which average above those of competitors. In hardiness and prolificacy they do not differ materially from other breeds. The females, usually good average milkers, are always capable of raising their own offspring.

The subjoined standard of excellence for bulls was adopted by the American Aberdeen-Angus Breeders' Association, Nov. 20, 1890. The same standard applies to cows with very little alteration.

Scale of Points for Aberdeen-Angus Cattle[1]

	Perfect score
1. **Color.**—Black. White is objectionable, except on the under-line behind the navel, and there only to a moderate extent; a white scrotum is most undesirable	3
2. **Head.**—Forehead broad; face slightly prominent, and tapering toward the nose; muzzle fine; nostrils wide and open; distance from eyes to nostrils of moderate length; eyes mild, full, and expressive, indicative of good disposition; ears of good medium size, well set and well covered with hair; poll well defined, and without any appearance of horns or scurs; jaws clean	10
3. **Throat.**—Clean, without any development of loose flesh underneath	3
4. **Neck.**—Of medium length, muscular, with moderate crest (which increases with age), spreading out to meet the shoulders, with full neck vein	3
5. **Shoulders.**—Moderately oblique, well covered on the blades and top; with vertebra or back-bone slightly above the scapula or shoulder-blades, which should be moderately broad	6
6. **Chest.**—Wide and deep; also round and full just back of elbows	10
7. **Brisket.**—Deep and moderately projecting from between the legs, and proportionately covered with flesh and fat	4
8. **Ribs.**—Well sprung from the back-bone, arched and deep, neatly joined to the crops and loins	8
9. **Back.**—Broad and straight from crops to hooks; loins strong; hook-bones moderate in width, not prominent, and well covered; rumps long, full, level, and rounded neatly into hind-quarters	10

[1] There is difference of opinion among animal-breeders regarding the value of the use of a score-card for judging stock. Most cattle-breeders' associations have adopted scales of points for judging purposes, whereas the horse-breeders' associations have not. The score-cards are introduced in this volume for their reference value, and as indicating the ideal types as held by those associations endorsing the score-cards. They are entered as a matter of record. The Editor does not thereby mean to express an opinion as to the value of the score-card idea.

Scale of Points for Aberdeen-Angus Cattle, continued

	Perfect score
10. **Hind-quarters.**—Deep and full; thighs thick and muscular, and in proportion to hind-quarters; twist filled out well in its "seam," so as to form an even, wide plain between thighs	8
11. **Tail.**—Fine, coming neatly out of the body on a line with the back and hanging at right angles to it	3
12. **Under-line.**—Straight as nearly as possible; flank deep and full	4
13. **Legs.**—Short, straight, and squarely placed, hind-legs slightly inclined forward below the hocks; forearm muscular; bones fine and clean . . .	4
14. **Flesh.**—Even and without patchiness	4
15. **Skin.**—Of moderate thickness and mellow touch, abundantly covered with thick, soft hair. (Much of the thriftiness, feeding properties, and value of the animal depends on this quality, which is of great weight in the grazier's and butcher's judgment. A good "touch" will compensate for some deficiencies of form. Nothing can compensate for a skin hard and stiff. In raising the skin from the body it should have a substantial, soft, flexible feeling, and when beneath the outspread hand it should move easily as though resting on a soft, cellular substance, which, however, becomes firmer as the animal ripens. A thin, papery skin is objectionable, especially in a cold climate.)	10
16. **General appearance.**—Elegant, well bred, and masculine. The walk square, the step quick, and the head up	10
Perfection	100

When bulls are exhibited with their progeny in a separate class, add 25 points for progeny.

In the early days of the breed there was not so much attention paid to what are now known as the fine points, but all of the care was directed to the individual merit. Color was a secondary consideration, and, while the great majority of the cattle were black, yet many good ones were marked with a dun-colored stripe down the back, while others were brindled, and still others were black and white, and not infrequently calves came of a peculiar pale red color caused by the absence of the black pigment, which is a characteristic of the breed. It was Hugh Watson of Keillor who first determined on the desirability of a uniform color in the breed, and who declared himself for the "Black and all black; the Angus Doddie, and no Surrender!"

Not so much care was exercised then as now in the choice of the sires, and in some cases animals were used that had rudimentary horns called scurs. These are small horn-like excrescences, that are not attached to the skull, and have no horn core. This condition is not considered to represent any impurity of the blood, but simply is a harking back to a time when the progenitors of these cattle were horned. Scurs are extremely objectionable from the present standpoint, and males so marked are debarred from registration. The fashion in color also demands that no white should appear above the under-line, but a white udder is said to be an indication of a good milch cow. The demand

for solid black color is carried, perhaps, beyond the proper point. There have been a number of attempts to get together the red-colored females, and to establish that color, but with only limited success, the offspring born of red parents coming true too frequently to the characteristic black color.

History.

Hornless cattle have existed for many centuries. Disregarding the uncertain, although probable, references of four to five thousand years ago, such cattle are definitely mentioned by Tacitus, the Roman historian. Herds of hornless cattle, at different times, have come into existence in various parts of the world. One of the largest of these is found in South America; another has grown up in Austria, and, within the last few years, hornless cattle have been developed among the well-established horned breeds, such as the Hereford, Jersey and Shorthorn, with which the wearing of horns seemed to be a fixed trait. Many words have been used to express this hornless condition in cattle, and they are known variously as humblies (humlies), muleys, doddies, hornless and polled. The latter term has become most generally in use to designate the Scotch hornless cattle. All of these words simply mean "lacking horns."

In Scotland, two breeds of such cattle have existed so long that history does not record their origins. These are the Galloway, whose habitat is the southwestern coast of Scotland, and the Aberdeen-Angus, which had its origin in the northeastern part of Scotland. It is somewhat difficult to describe these breeds so that representatives of each may be readily distinguished; both are hornless, both black and both come from Scotland. Generally speaking, the Galloways are much longer-haired, larger-boned, more square-framed and somewhat slower-maturing, while the Aberdeen-Angus are sleek-haired, small-boned, round in the barrel and hind-quarters and early-maturing.

The earliest attempt to improve the polled cattle of the northeast of Scotland began in Angusshire, which is now a part of Forfarshire, and was undertaken by the late Hugh Watson of Keillor. His ancestors had been breeding these cattle on the Keillor farm for more than two hundred years when Hugh Watson began in 1805. Not many years later, cattle-breeders in Aberdeenshire began improving the same kind of cattle, and a considerable rivalry sprang up between the different localities. According to the location, the cattle were known as the Angus Doddie and as Buchan Humblies, and yet again as Polled Aberdeens. The word polled was used to indicate the hornless Aberdeenshire cattle and thus to distinguish them from another breed, now almost extinct, which inhabited the same shire and had horns.

At a still later time the breeders of these hornless cattle in the various parts of northeastern Scotland came together, and, deciding that the cattle were all of one breed, proceeded to choose a suitable name. To please the partisans of the two districts in which most of these cattle were then

to be found, the name adopted was Polled Aberdeen-or-Angus cattle. This name became shortened by dropping out the word "or" and putting a hyphen in its place. It has been further abbreviated, because of the passing of the horned breed, to Aberdeen-Angus, the word polled being now deemed unnecessary. This idea has been adopted also by the Polled Galloway breeders, so that their breed is now known as Galloway cattle. Both in Scotland and America, even the name of Aberdeen-Angus has been shortened, and in Scotland the cattle are generally referred to as the Polled cattle, while in America they are called the Angus cattle.

These Aberdeen-Angus cattle have been great favorites in Scotland for more than a century, but unfortunately on two occasions diseases attacked the cattle in that country and decimated the herds. Later, when the government had stamped out these diseases, the cattle again began multiplying, and soon assumed an important place among the domestic animals of the kingdom. The World's Fair held at Paris, France, in 1878, gave the breed an opportunity to demonstrate its great merit, and, with only fifteen representatives, it won the champion-herd prize against nearly two thousand other cattle of various breeds shown in competition, every animal of the Aberdeen-Angus breed receiving either a prize or an honorable mention. About this time the breed was introduced into England, and a little later into Ireland.

In America.—The Paris successes led some of the former breeders of these cattle, then in America, to bring over a few of their early favorites in 1878, and from that time this breed of cattle has grown rapidly in public favor until it is now recognized as one of the principal beef breeds of this country. In 1872, two bulls were sent to western Kansas, but no females accompanied that importation. It was the marketing of the steers from these two animals that first attracted attention to this breed in Kansas City. Other importations were

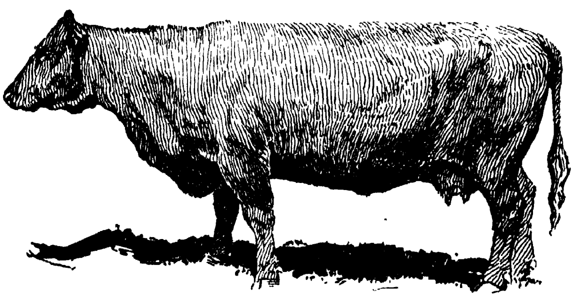

Fig. 361. **Aberdeen-Angus cow.** Jilt 15th.

made as follows: In 1876, two bulls and a cow, by the Ontario Agricultural College; in 1878, one bull and five cows, by Anderson & Findlay, Lake Forest, Illinois; in 1879, by F. B. Redfield, Batavia, New York; in 1880, by George Whitfield, Rougemont, Province of Quebec. Since that time many importations have been made.

The lack of horns was such an unusual condition that it excited much comment and not a little opposition. When breeders and feeders began to consider this feature, its decided advantage so appealed to them that a perfect furor of dehorning[1] swept over the country. Horns were sawed off from aged animals, and horn-cores were gouged out or burnt off of calves, until dehorned market

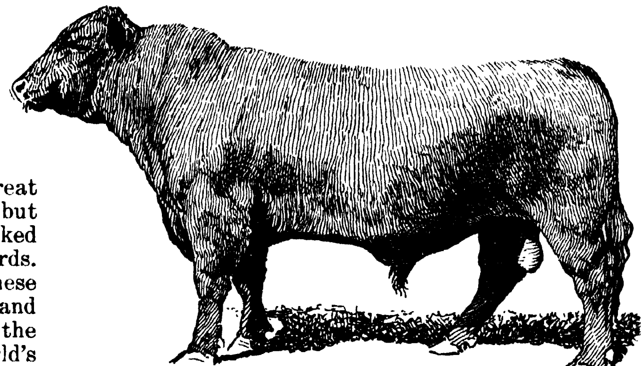

Fig. 360. **Aberdeen-Angus bull.** Heather Monk.

cattle became the rule instead of the exception. The Aberdeen-Angus bull has become a prime favorite as a dehorner. Crossed with the ordinary native cow, about 90 to 95 per cent of the offspring are black in color and hornless, although occasionally scurs appear, which, however, are no detriment from the feeder's point of view.

The Aberdeen-Angus cattle rapidly rose in public favor. Sales were held at various points, and the cattle were scattered over a large territory. Perhaps there is no other instance in which a new and practically unknown breed has sprung at once into such prominence and has maintained so high a position.

Distribution.

Cattle of this breed are found in Scotland, England, Ireland, Germany, France, Denmark, Sandwich Islands, New Zealand, South America, Canada, and the United States. In America the breed is represented in not less than forty-two states and territories. Especially adapted to the rich prairie lands of the Middle West, Aberdeen-Angus cattle for years have been most numerous in the states of Iowa, Illinois, Missouri, Indiana, Kansas, Ohio, and Nebraska, in the order given. However, they are widely distributed, and in recent years have increased substantially in popular favor in the Southwest, West and Northwest. Preëminently a feed-

[1] There is not full agreement as to the word *dehorn*, some persons holding it to be etymologically incorrect, and preferring *dishorn* on the assumption that *de* should not be prefixed to a stem beginning with *h* followed by a vowel. There is abundant precedent for *dehorn*, however, in such words as *dehort, dehypnotize, dehisce, dehydrate, dehusk*, and others; and *de* is perhaps preferable when the idea is to denote the taking away of one or two smaller things from larger or more permanent things, whereas *dis* seems to imply the dispersion of things from each other. In this country, the word *dehorn* seems to be so well established as to give assurance of permanence, whatever its etymological status.

er's beast, the Aberdeen-Angus not only is highly prized by beef-producers in the corn-belt, but graziers and ranchmen of the plains region of the West, Southwest and Northwest find it a profitable breed for their conditions. It is in the surplus corn states, however, that Aberdeen-Angus cattle appear to reach their highest excellence.

Uses.

For milk.—The breed has not been developed particularly for milk-production, but in some herds attention has been given to this quality with the result that, more particularly in New Zealand, entire dairies are now composed of Aberdeen-Angus cows; and in 1895, an Aberdeen-Angus cow was the champion at the Dairy Show held in London.

For beef.—The cattle and their grades are more especially noted for the wealth of flesh carried on very short legs, and are easy keepers and early maturing. For the past twenty years this breed has uniformly topped the Chicago market each year with one exception, and in that year the Pittsburg market paid a higher price than any other, and the Aberdeen-Angus topped that market. Their winnings in the International Live-stock Exposition are matters of current history, and they have never failed of representation among the prize-winners, both as single animals and in carload lots.

For crossing or grading, the Aberdeen-Angus is in the front rank. On common stock, the bulls get market cattle of high merit. As dehorners, the bulls of this breed are unexcelled. A wider use of these bulls in grading would be beneficial.

Organizations and records.

The two leading organizations concerned with the advancement of the interests of Aberdeen-Angus cattle are the Polled Cattle Society of Scotland, organized in 1879, and the American Aberdeen-Angus Breeders' Association, organized in 1883, with headquarters in the Live-stock Record Building, Chicago. Thirty-one volumes of the Polled Cattle Herdbook have been issued since 1862. When the Polled Cattle Herdbook was first established in Scotland, Galloway cattle were recorded in it as well (in first four volumes), but all animals of that breed were designated by an asterisk placed in front of their names, and no animals were accepted that were a cross between the Aberdeen-Angus and the Galloway, but both breeds were kept distinct. Since 1886, the American association has published sixteen volumes of its herdbook. Over 100,000 Aberdeen-Angus cattle have been registered in the American herdbook, but of course a considerable proportion of these were the foundation animals whose pedigrees were taken from the Scotch herdbook; about 15 per cent of the annual produce of pure-bred herds is not recorded. There are now about one thousand members in the American association.

There are also several state organizations, as the Indiana, Iowa, and Nebraska Aberdeen-Angus Breeders' Associations. These have memberships of seventy-five to one hundred and fifty persons, hold regular annual meetings, appropriate money for special prizes at the state fairs, and in other ways seek to promote the interests of the breed.

Literature.

Aberdeen-Angus, The Breed that Beats the Record, Detroit (1886); James Macdonald and James Sinclair, History of Polled Aberdeen or Angus Cattle, Edinburgh (1882); A History of the Heatherton Herd, Chicago (1907). [For further references, see page 302.]

Ayrshire Cattle. Figs. 362, 363.

By *Harry Hayward.*

The Ayrshire is one of the principal breeds of dairy cattle in America.

Description.

The individual Ayrshire is an animal of medium size, the standard weight for mature cows being one thousand pounds, while bulls should weigh fifteen hundred pounds or more. In general conformation it is, perhaps, a little smoother than the Jersey and Holstein, yet it is not so smooth as to conceal the wedge shape of the body when viewed from behind. A little peculiarity frequently seen in the Ayrshire is that the tips of the ears are notched. The horns are white, with black tips, and curve outward and upward. They may attain large size. The body is large and deep and the ribs well sprung; the rump is broad and long, and is usually set high. The hind-quarter is frequently heavy The udder in a good dairy type shows high development of form and setting. This character is rather uniform in the breed. The color is variable, through red, white and brown. The prevailing color in America is red and white patches, with a tendency toward a predominance of white. In disposition the Ayrshire is mild and kind, yet alert, active and energetic. The evidence she gives of being full of reserve force is one of her strongest characteristics.

The following scale of points, adopted by the American Ayrshire Breeders' Association and the Canadian Ayrshire Breeders' Association, in 1906, shows what is desired in the breed.

SCALE OF POINTS FOR AYRSHIRE CATTLE

For cows

	Perfect score
1. **Head** (10)	
Forehead.—Broad and clearly defined	1
Horns.—Wide set on and inclining upward . .	1
Face.—Of medium length, slightly dished, clean cut, showing veins	2
Muzzle.—Broad and strong without coarseness; nostrils large	1
Jaws.—Wide at the base and strong	1
Eyes.—Full and bright, with placid expression .	3
Ears.—Of medium size and fine, carried alert .	1
2. **Neck.**—Fine throughout; throat clean; neatly joined to head and shoulders, of good length, moderately thin, nearly free from loose skin, elegant in bearing	3
3. **Fore-quarters** (10)	
Shoulders.—Light, good distance through from point to point but sharp at withers, smoothly blending into body	2

SCALE OF POINTS FOR AYRSHIRE CATTLE, continued

For cows	Perfect score
Chest.—Low, deep and full between and back of fore-legs	6
Brisket.—Light	1
Legs and feet.—Legs straight and short, well apart; shanks fine and smooth, joints firm; feet medium size, round solid and deep . . .	1
4. **Body** (13)	
Back.—Strong and straight, chine lean, sharp and open-jointed	4
Loin.—Broad, strong and level	2
Ribs.—Long, broad, wide apart and well sprung .	3
Abdomen.—Capacious, deep, firmly held up with strong muscular development	3
Flank.—Thin and arching	1
5. **Hind-quarters** (11)	
Rump.—Wide, level and long from hooks to pin-bones, a reasonable pelvic arch allowed . .	3
Hooks.—Wide apart and not projecting above back nor unduly overlaid with fat.	2
Pin-bones.—High and wide apart	1
Thighs.—Thin, long and wide apart	2
Tail.—Long, fine, set on a level with the back .	1
Legs and feet.—Legs strong, short, straight when viewed from behind and set well apart; shanks fine and smooth, joints firm; feet medium size, round, sold and deep	2
6. **Udder.**—Long, wide, deep, but not pendulous nor fleshy; firmly attached to the body, extending well up behind and far forward; quarters even; sole nearly level and not indented between teats; udder veins well developed and plainly visible	22
7. **Teats.**—Evenly placed, distance apart from side to side equal to half the breadth of udder, from back to front equal to one-third the length; length 2½ to 3½ inches, thickness in keeping with length, hanging perpendicular and not tapering	8
8. **Mammary veins.**—Large, long, tortuous branching and entering large orifices	5
9. **Escutcheon.**—Distinctly defined, spreading over thighs and extending well upward	2
10. **Color.**—Red of any shade, brown, or these with white; mahogany and white, or white; each color distinctly defined. (Brindle markings allowed but not desirable.)	2
11. **Covering** (6)	
Skin.—Of medium thickness, mellow and elastic	3
Hair.—Soft and fine	2
Secretions—Oily, of rich brown or yellow color .	1
12. **Style.**—Alert, vigorous, showing strong character; temperament inclined to nervousness but still docile	4
13. **Weight** at maturity not less than one thousand pounds	4
Perfection	100

For bulls	Perfect score
1. **Head** (16)	
Forehead.—Broad and clearly defined	2
Horns.—Strong at base, set wide apart, inclining upward	1
Face.—Of medium length, clean cut, showing facial veins	2
Muzzle.—Broad and strong without coarseness.	1
Nostrils.—Large and open	2
Jaws.—Wide at the base and strong	1
Eyes.—Moderately large, full and bright . .	3

SCALE OF POINTS FOR AYRSHIRE CATTLE, continued

For bulls	Perfect score
Ears.—Of medium size and fine, carried alert .	1
Expression.—Full of vigor, resolution and masculinity	3
2. **Neck.**—Of medium length, somewhat arched, large and strong in the muscles on top, inclined to flatness on sides, enlarging symmetrically towards the shoulders; throat clean and free from loose skin	10
3. **Fore-quarters** (15)	
Shoulders.—Strong, smoothly blending into body, with good distance through from point to point, and fine on top	3
Chest.—Low, deep and full between back and fore-legs	8
Brisket.—Deep, not too prominent and with very little dewlap	2
Legs and feet.—Legs well apart, straight and short; shanks fine and smooth, joints firm; feet of medium size, round, solid and deep .	2
4. **Body** (18)	
Back.—Short and straight, chine strongly developed and open-jointed	5
Loin.—Broad, strong and level	4
Ribs.—Long, broad, strong, well sprung and wide apart	4
Abdomen.—Large and deep, trimly held up with muscular development	4
Flank.—Thin and arching	1
5. **Hind-quarters** (16)	
Rump.—Level, long from hooks to pin-bones .	5
Hooks.—Medium distance apart, proportionately narrower than in female, not rising above the level of the back	2
Pin-bones.—High, wide apart	2
Thighs.—Thin, long and wide apart	4
Tail.—Fine, long and set on level with back .	1
Legs and feet.—Legs straight, set well apart, shanks fine and smooth; feet medium size, round, solid and deep, not to cross in walking.	2
6. **Scrotum.**—Well developed and strongly carried .	3
Rudimentaries, veins, etc.—Teats of uniform size, squarely placed, wide apart and free from scrotum; veins long, large, tortuous, with extensions entering large orifices; escutcheon pronounced and covering a large surface	4
7. **Color.**—Red of any shade, brown, or these with white, mahogany and white, or white; each color distinctly defined	3
8. **Covering** (6)	
Skin.—Medium thickness, mellow and elastic .	3
Hair.—Soft and fine	2
Secretions.—Oily, of rich brown or yellow color.	1
9. **Style.**—Active, vigorous, showing strong masculine character; temperament inclined to nervousness but not irritable or vicious . .	5
10. **Weight** at maturity not less than 1500 pounds .	4
Perfection	100

History.

The Ayrshire did not have its origin in this country, but was brought from Scotland, its native home, in the early part of the last century. It takes its name from the county Ayr, although in its formative period it was known as the Dunlop and the Cunningham breed.

From the descriptions of Ayr and the adjacent territory, given by Low, an English writer on agri-

cultural matters, it may be inferred that agricultural conditions in that country, at the close of the Revolutionary War, were at a low ebb. "There were no fallows, no sown grasses, no carts nor wagons and no straw yards; no roots were grown, very little straw and no hay, save the small

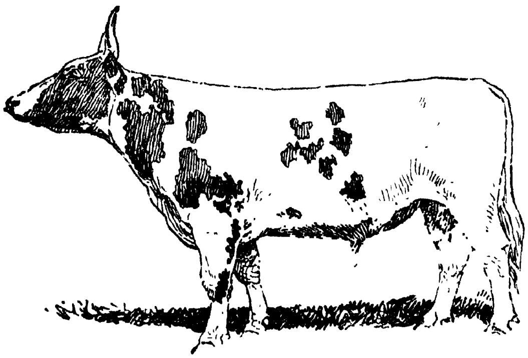

Fig. 362. Ayrshire bull, Nether Craig Spicy Sam.

amounts cut from the bogs and wastes. Under these conditions the cattle were starved in winter, being scarcely able to rise in the spring, and never were in condition fit for the market." Such were the conditions from which the hardy, useful race of Ayrshire cattle has come. Culley, who wrote a treatise on live-stock before the year 1790, does not mention the Ayrshire as one of the recognized breeds of the country. From this we may conclude that their history as a breed begins some time shortly after the first of the past century; previous to that time, they were one of the coarse varieties of cattle which formerly occupied all of the southern part of the country.

The earliest recognition which they received as a breed was given by a Mr. Aiton, who published a treatise on the Dairy Husbandry of Ayrshire, in 1825. He describes them, according to Low, as being a puny, unshapely race, not superior to the cattle of the higher districts, referring, perhaps, to the West Highland or Kylo cattle. He further states that the Ayrshires, at that time, were mostly black in color, marked with white in the face, down the back and flank, and that few of the cows gave more than a gallon and a half or two gallons of milk per day when fresh. They were very small in size, so small that the average dressed weight of mature animals was but two hundred and eighty pounds.

This description was written after the introduction into the Ayrshire district, it is asserted, of the cattle descended from the crosses made with the Teeswater or Holderness stock from Durham, England. The Earl of Marchmont is supposed to have brought this foreign blood into Scotland between 1724 and 1740. This importation of a bull and several cows was taken to the earl's estates in Berwickshire on the east coast of Scotland.

It has been thought that the Alderney (or, presumably, Jersey) cross was also introduced into the Ayrshire district at this time. An evidence that the Alderney was used is the small head and slender neck possessed in common by both these breeds. In spite of the lack of historical evidence that Jersey cattle were crossed on the old Ayrshire stock, Low concludes that the "Dairy Breed of Ayrshires owes the characteristics which distinguish it from the older race to mixture with the blood races of the continent and of the Dairy Breeds of Alderney."

From the above, we may rightly infer that the conditions which surrounded the foundation of the Ayrshire breed were such that the fittest only could survive. This factor of hardiness was apparently but little disturbed, if any, when the Teeswater cross was made. Hardihood has been so closely interwoven with every fiber of the Ayrshires that they are today the most hardy of all breeds of dairy cattle, with the possible exception of the Irish Kerry. It is probable that the Teeswater cross eventually increased the milk-producing ability of the Ayrshire.

What is true of many of our improved breeds of cattle is true, also, of the Ayrshire: that no one breeder stands out prominently from his fellows as the great improver of the breed. The dairy-farmers of Ayr and the adjacent counties worked together for the common purpose of developing a hardy, active race of cattle adapted to the humid climate and sparse hillside pastures, as well as a race that would produce the maximum amount of milk when fed on chaffed straw and roots during the long winters of Scotland. Their success is indicated by the very large number of exportations from Scotland to other countries.

In America.—Ayrshire cattle were first imported into America between 1820 and 1830. Importations continued to be made into the eastern states with more or less regularity up to about the beginning of the Civil war. Importations are thought to have been made in 1822 by H. W. Hills, of Windsor, Connecticut; about 1837 by John P.

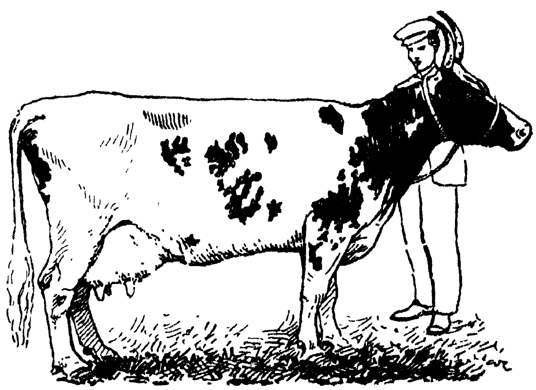

Fig. 363. Ayrshire cow.

Cushing, of Massachusetts, and in 1848 by E. A. Brown, of Ohio. While the imported cattle gave their owners entire satisfaction as far as hardiness, ease of keeping and milk-production were concerned, they failed to find much favor where the milking is done by men, because of the shortness of their teats. In Canada and in Scotland, where women milk by stripping with the thumb and fore-

finger, this fault was not the serious objection that it was in eastern United States. It is possible, too, that another reason why Ayrshires did not grow in favor more rapidly was that the center of the breed, in its early history in the United States, was in New England, and in the hands of dairy-farmers. The cattle were kept for practical purposes, and but little attention was paid to breed characteristics, to exhibiting at the fairs, or to advertising the merits of the breed in any other way.

Distribution.

The Ayrshires are practically the only dairy cattle in Scotland, and nearly every country in which dairying is an important industry has drawn heavily on Scotland for foundation stock. The principal countries that are using Ayrshires are Canada, the United States, Norway, Sweden, Finland and Russia. They are also found in considerable numbers in South Africa, New Zealand, Australia, China and Japan. In America, the breed is found in largest numbers in Quebec and Ontario, in Canada, but it is fast becoming popular in eastern United States, notably in the New England States, New York and Pennsylvania. There are a few herds in Ohio, Illinois, Missouri, Oregon and California.

Types of Ayrshire cattle.

The event which served to bring the Ayrshires from their obscurity in America, and but for which they might still have been comparatively unknown, was the World's Columbian Exposition, held in Chicago in 1893. At this great World's Fair two distinct types of Ayrshire cattle appeared in competition; the American or New England type, which, having received no fresh infusion of blood from the mother country for many years, had become to all intents and purposes another breed, and the Canadian or, more properly, the Scotch type. This type was represented solely by animals that conformed to the type generally held by every one but American breeders to be the correct one, and many individuals had been prize-winners at the important agricultural shows in Scotland.

The New England cattle differed from those of Scotch type in that they were a little shorter in the leg, heavier bodied, and possessed better handling qualities. Their udders, while large and capacious, were hardly level and square, and in many cases were rather pendulous. The teats were of good size and length, and of a dark or tan color; the horns frequently were crumpled, and the colors were dark-brown or cherry-red, flecked with white. While these cattle possessed unquestioned dairy merits, they did not have the uniformity of type that should be characteristic of a recognized breed.

The Scotch cattle were longer and not relatively so deep in the body as their competitors; a trifle longer in the leg; hardly so rugged, perhaps; straighter from the poll to tail-head; possessed of large, square, level udders, whose front quarters were particularly well-developed, closely attached to the body, with teats ideally placed, but too often not only small in size but very short in length. It is stated by some authorities that a closely attached udder is very rarely found with long teats. Other characteristics of these Scotch Ayrshires were their heavy skins, broad upward-turned horns, and their color, which was white, with varying shades of red spots on the head and neck; frequently there were larger or smaller spots on the body, but, in most cases, at least, the white predominated. Furthermore, all of the cattle exhibited by the Canadians showed a uniformity of breed characteristic or type that was plainly evident to the most casual observer. It was this uniformity, as well as their distinctive showy attractiveness, that drew to the foreign cattle the attention of the visitors in the stadium, as well as that of the American breeders in and outside of the judging arena.

The judge on this occasion had been selected from Canada, and, naturally, was partial to the Scotch type. As a consequence, most of the prizes went to the Canadian exhibitors. While the American exhibitors were bitterly disappointed, the decisions made at Chicago have had a far-reaching effect in changing the type of Ayrshire cattle in America. Since that time the majority of the most progressive breeders either have made direct importation from Scotland, or have placed at the head of their herds bulls of the Scotch type. This is particularly true of those who exhibit at the leading fairs. And, when competition comes between this and the old New England type, the former nearly always wins.

The question of type had become so confusing that early in the year 1906 the officials of the American, Canadian, and Scotch Ayrshire breeders' associations recognized it as worthy of their attention. The result was that they agreed on a uniform scale of points (see page 333), which is intended to serve as a guide for the breeders of all three associations.

Breeders of these cattle have never practiced inbreeding to any great extent, and there are no well-defined families or strains, as in other breeds.

Uses.

For milk and butter.—In point of milk-yield alone, the Ayrshire does not compare favorably, individual for individual, with the Holstein, nor in butter-production alone with either the Jersey or Guernsey. But in the yield of milk and butter, on rough, hilly pastures, or without heavy grain-feeding in the winter, the Ayrshire is in a class by herself. It is difficult to give figures of production that are at all representative, since as much, if not more, depends on the system of care and management as on the cow herself. From reports of a number of herds which may be considered reliable, as indicating the dairy qualities of the Ayrshire breed, it may be stated that herds numbering twenty animals of all ages, will yield as an average, 6,500 pounds of milk, and 300 pounds of butter. This estimate presupposes that the herd is fed for profit, but not forced in any sense of the word. A number of herds fed a liberal allowance of grain the year round, and managed with the view of yielding the maximum amount of milk and

butter, have averaged over 8,000 pounds of milk, and 350 pounds of butter. Because the Ayrshire cow is perhaps not capable of making forced weekly, or even yearly milk and butter records equal to those of some of the other breeds, and furthermore, because she has been so completely in the hands of practical dairymen, she has never been forced in her production in the generally accepted sense of the term. As a consequence, the cows of this breed are in a more normal condition than those of almost any other.

Because the butter-fat globules are small, the cream does not rise so quickly as in the case of some of the other dairy breeds, and as a consequence Ayrshire milk is well adapted for shipping to city markets, and for use as a beverage

For cheese.—It was formerly thought that Ayrshire milk was peculiarly adapted to cheese-making. With our present-day information on this subject, however, this view is no longer generally held, although the milk is used for this purpose.

For beef.—As far as a dairy cow can be a beef animal, the Ayrshire probably excels, for the reason that she is a little smoother in conformation than the other dairy breeds, and the fat of the carcass, instead of being yellow, which is objectionable to the consumer, is white.

For crossing.—An Ayrshire bull at the head of a grade herd will greatly increase milk-production in its progeny. When used on grade cows the standard of the herd will be materially elevated.

Organizations and records.

The welfare and interests of this race of cattle are in charge of the American Ayrshire Breeders' Association, which was organized on its present basis in 1875. The breeder's of Ayrshires, however, have done systematic work for the breed through the Association of Breeders of Thoroughbred Neat Stock, as far back as 1859. The latter organization published three volumes of a herd register. On the organization of the former association, the publication of the Ayrshire Record came into its hands. Since 1876 it has published sixteen volumes (new series). The North American Ayrshire Register first appeared in 1875, devoted to cattle that could be traced to importation. It was discontinued in 1880, after four volumes had been published. Aside from guarding the purity of the breed, the American Ayrshire Breeders' Association also conducts a yearly home dairy test and an advanced registry. Both of these divisions of the Association's work tend to encourage the development of the breed by creating a greater interest among the members of the Association, to excel either in making official records, or in making attractive displays of their cattle at leading agricultural exhibitions. The present headquarters of the Association are at Brandon, Vt.

There was organized in 1870 the Ayrshire Importers' and Breeders' Association of Canada, and in 1889 the Dominion Ayrshire Breeders' Association. In 1898, the former was absorbed by the latter. The Montreal Ayrshire Herdbook first appeared in 1886. It was later united with the Dominion Ayrshire Herdbook, which appeared in 1884, and published as the Canadian Ayrshire Record.

Literature.

Yearbook, published annually by the Ayrshire Breeders' Association; E. L. Sturtevant, The Dairy Cow: A Monograph of the Ayrshire Breed of Cattle, Boston (1875). [For further references, see page 302.]

Brown Swiss Cattle. Figs. 364, 365.

By *Charles D. Nixon.*

The Brown Swiss cattle of America are a distinct dairy breed. They have been generally known as a dual-purpose breed, but the American Brown Swiss Cattle Breeders' Association, at its late meeting, decided to establish only a distinct dairy breed.

Description.

As a breed the Brown Swiss cattle are fairly large, the cows averaging 1,200 pounds and the bulls 1,800 pounds, with a beautiful symmetrical form, covered with a soft mellow skin of unusual thickness, giving the animal a sleek, fat appearance. The color is a shade from light to dark chestnut brown. The peculiar markings are a light tuft of hair between the horns, on the inside of the ears and a narrow line along the back. The nose is black, with mouth surrounded with a meal-colored band; a yellow strip along the middle of the under lip crosses over to the upper lip and extends up the sides of the nostrils. The horns are of medium size and length, well set, with black tips; face dishing, with a large, full eye, denoting energy and vigor. The tail is long, with heavy black switch. The hoofs and tongue are also black. The hind-legs are straight, with thighs well cut out before and behind. The udder is large, extending well up in front and rear. The teats are large and well placed at the corners of the udder, with a beautifully formed escutcheon. The ribs are well sprung. The heart girth is large, pelvic arch high and hips broad. The short legs give the appearance of under weight, differing from other dairy breeds in that they have a stronger and more vigorous appearance.

The following scale of points, adopted by the American Brown Swiss Cattle Breeders' Association, shows what is desired in this breed.

Scale of Points for Brown Swiss Cattle

	Perfect score
1. **Head.**—Medium size and rather long	2
2. **Face.**—Dished, broad between the eyes and narrow between the horns	2
3. **Ears.**—Of a deep orange color within	1
4. **Nose.**—Black, square, and with the mouth surrounded by a light, meal-colored band; tongue black	2
5. **Eyes.**—Full and placid	1
6. **Horns.**—Rather short, flattish and regularly set with black tips	5
7. **Neck.**—Straight, rather long and not too heavy at shoulders	4
8. **Chest.**—Broad and deep	4

Scale of Points for Brown Swiss Cattle, continued

	Perfect score
9. **Back.**—Level to the setting-on of the tail and broad across the loin	6
10. **Barrel.**—Hooped, broad and deep at the flank	8
11. **Hips.**—Wide apart, rump long and broad	4
12. **Thighs.**—Wide, with heavy quarters	4
13. **Legs.**—Short and straight, with good hoofs	4
14. **Tail.**—Slender, pliable, not too long, with good switch	4
15. **Hide.**—Thin and movable	3
16. **Color.**—Shades from dark brown to light brown, and at some seasons of the year gray; slight splashes of white near udder, not objectionable; light stripe along the back	6
17. **Hair.**—Between horns light, not reddish; hair on inside of ears light. (No points.)	
18. **Fore-udder.**—Full in form and carried up, reaching far forward on the abdomen	10
19. **Hind-udder.**—Not too deeply hung, full in form and well up behind	10
20. **Teats.**—Rather large, set well apart and hanging straight down	5
21. **Milk veins.**—Prominent	4
22. **Escutcheon.**—High and broad, and full in thighs	7
23. **Disposition.**—Quiet and good natured	4
Perfection	100

In judging bulls and heifers, omit Nos. 14, 15 and 16; and for color they should be dark brown.

History.

This breed is descended from the Brown Switzer or Schwyzer cattle, established from a time beyond historic record in the mountainous country of Switzerland, especially in the Cantons of Zürich, Zug and Schwitz or Schwyz.

In America.—The first importation of Brown Swiss cattle, consisting of seven cows and one bull, was made by Henry M. Clark, of Belmont, Mass., in 1869. They were subsequently sold to D. Hall, of Providence, R. I., and D. G. Aldrich, of Worcester, Mass. From them and subsequent importations by W. Koch and J. B. Eldredge, of New York; Scott & Harris, of Connecticut; E. M. Barton, of Illinois, and McCormick Brothers, have sprung the 2,500 bulls and 3,700 cows since registered as pure-bred cattle by the Brown Swiss Cattle Breeders' Association. In 1904, McLaury Brothers, of New York State, made a large importation.

Distribution.

Brown Swiss cattle are in high favor in Europe, especially in Russia, Germany and Italy. In Switzerland they are the most popular milk-producing cattle. They are rather generally scattered over the United States. Some of the larger herds are now in Missouri, Illinois and Wisconsin, and are used almost exclusively for dairy purposes. They are also found in Mexico. Very few of them are offered for sale and they are seldom sold except at a high price, owing to their pleasant, kindly disposition and their rare excellence for milk and butter. Their ruggedness and ability to thrive on rough, sparse pastures, adapts them to a wide range of conditions.

Feeding and care.

As has been said, the Brown Swiss cattle originated in the mountainous country of Switzerland, where the feed is grass and hay alone and where grains are scarce and expensive. They grazed on the mountain side in the summer and were fed hay in the valley in the winter. However, they respond very quickly to good care and feed in every part of the United States. Alfalfa hay is especially recommended as one of the best feeds to develop the Brown Swiss.

Uses.

For milk and butter.—They are persistent milkers and usually produce large averages for the year, occasionally as high as 10,000 pounds of milk and 500 pounds of butter-fat. The milk is adapted for condensing, and for butter and cheese production. They will produce more milk and butter-fat on rough feed than any of the other dairy breeds. The average per cent of butter-fat is 4.3. In 1891, the cow Brienz No. 168, at the age of twelve years, in a carefully supervised test at Chicago, made the very notable record of an average yield of 81.7 pounds of milk per day for three days, containing 9.32 pounds of butter-fat.

For beef.—Brown Swiss cattle have not been popular as beef-producers in America, although they are highly prized for this purpose in Switzerland. They fatten rapidly and attain good size. They dress out about 60 per cent. The calves make excellent veal at six weeks.

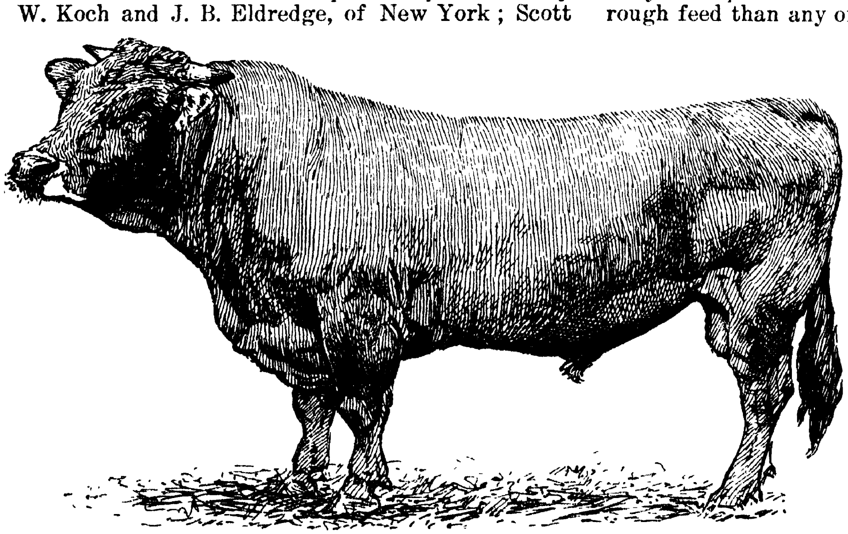

Fig. 364. Imported Brown Swiss bull. Luob, No. 2107.

weighing 250 to 300 pounds. They produce a white, highly flavored meat.

For crossing.—The use of Brown Swiss bulls on grade cows to produce veal calves is highly recommended. Many farmers fatten them on skimmed milk and sell them alongside other calves fattened on whole milk. They are also valuable for crossing on debilitated common stock for infusing new vigor.

Organizations and records.

The American Brown Swiss Cattle Breeders' Association, organized in 1880, cares for the interests of the breed in this country. It is made up of less than 100 Brown Swiss breeders, many of them millionaire farmers who take great pride in this stock. To date it has published three small herdbooks.

Literature.

For references, see page 302.

Devon Cattle. Figs. 366, 367.

By *L. P. Sisson.*

The Devon is a dual-purpose breed of cattle, containing both beef and dairy types. Because of the bright red color the animals are sometimes called "Rubies."

Description.

In general, the Devons are a docile but hardy breed of cattle, well adapted to thrive on short and hilly pasture, while at the same time responding to good care. The following scale of points, adopted by the American Devon Cattle Club, November 11, 1886, shows what is desired in the breed. Purity of blood must be evidenced by registry in the American Devon Record.

SCALE OF POINTS FOR DEVON CATTLE

For cows	Perfect score
1. **Head.**—Moderately long, with a broad indented forehead, tapering considerably towards the nostrils; the nose of a flesh-color, nostrils high and open; the jaws clean; the eye bright, lively and prominent, and surrounded by a flesh-colored ring; throat clean; ears thin; the expression gentle and intelligent; horns matching, spreading and gracefully turned up, of a waxy color, tipped with a darker shade	8
2. **Neck.**—Upper line short, fine at head, widening and deep at withers and strongly set to the shoulders	4
3. **Shoulders.**—Fine, flat and sloping, with strong arms and firm joints	4
4. **Chest.**—Deep, broad, and somewhat circular in character	8
5. **Ribs.**—Well sprung from the back-bone, nicely arched, deep, with flanks fully developed	8
6. **Back.**—Straight and level from the withers to the setting-on of the tail; loin broad and full; hips and rump of medium width, and on a level with the back	16
7. **Hind-quarters.**—Deep, thick and square	8
8. **Udder.**—Not fleshy, coming well forward in line with the belly and well up behind; teats moderately large, and squarely placed	20

SCALE OF POINTS FOR DEVON CATTLE, continued

For cows	Perfect score
9. **Tail.**—Well set on at a right angle with the back, tapering, with a switch of white or roan hair and reaching the hocks	2
10. **Legs.**—Straight squarely placed when viewed from behind, not to cross or sweep in walking; hoof well formed	4
11. **Skin.**—Moderately thick and mellow, covered with an abundant coat of rich hair of a red color; no white spot admissible, except the udder	8
12. **Size.**—Minimum weight at 3 years old, 1,000 pounds	2
13. **General appearance.**—As indicated by stylish and quick movement, form, constitution and vigor, and the under-line as nearly as possible parallel with the line of the back	8
Perfection	100

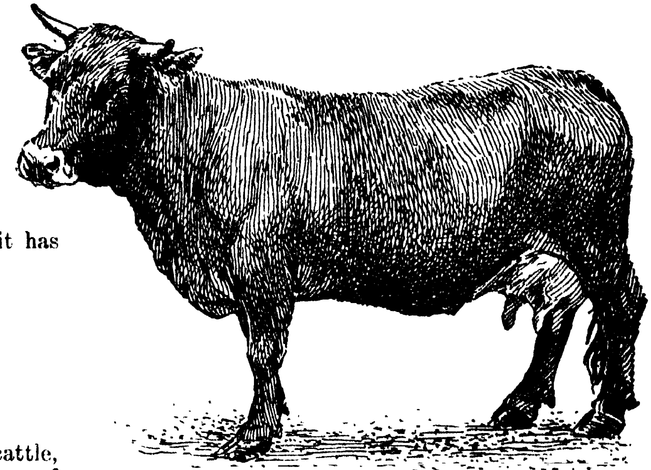

Fig. 365. A notable Brown Swiss cow. Florine of River Meadow, No. 1407.

For bulls	Perfect score
1. **Head.**—Masculine, full and broad, tapering toward the nose, which should be flesh-colored; nostrils high and open; muzzle broad; eyes full and placid and surrounded with flesh-colored ring; ears of medium size and thickness; horns medium size, growing at right angles from the head, or slightly elevated, waxy at the base, tipped with a darker shade	10
2. **Cheek.** Full and broad at root of tongue; throat clean	2
3. **Neck.**—Of medium length and muscular, widening from the head to the shoulders, and strongly set on	4
4. **Shoulders.**—Fine, flat, sloping and well fleshed; arms strong with firm joints	6
5. **Chest.**—Deep, broad and somewhat circular	10
6. **Ribs.**—Well sprung from the back-bone, nicely arched, deep with flanks fully developed	10
7. **Back.**—Straight and level from the withers to the setting-on of the tail; loin broad and full; hips and rump of medium width and on a level with the back	20
8. **Hind-quarters.**—Deep, thick and square	12

Scale of Points for Devon Cattle, continued

For bulls	Perfect score
9. **Tail.**—Well set on at a right angle with the back, tapering, with a switch of white or roan hair and reaching the hocks	2
10. **Legs** —Short, straight and squarely placed when viewed from behind, not to cross or sweep in walking; hoof well formed	4
11. **Skin.**—Moderately thick and mellow, covered with an abundant coat of rich hair of a red color; no white spot admissible unless around the purse	8
12. **Size.**—Minimum weight at 3 years old, 1,400 pounds	4
13. **General appearance.**—As indicated by stylish and quick movement, form, constitution and vigor, and the under-line as nearly as possible parallel with the line of the back	8
Perfection	100

History.

From time immemorial there has been known in the south and west of England and on the borders of Wales, especially in the county of Devon, a

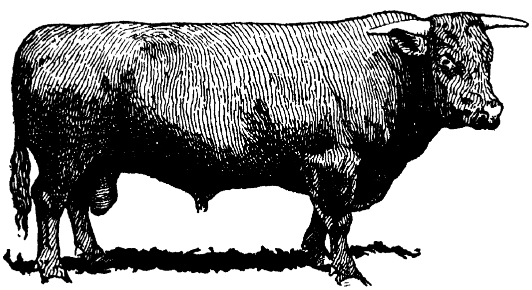

Fig. 366. Devon bull. Allround 6498.

breed of cattle of uniform red color, rather long and graceful horns, well-rounded and symmetrical bodies and straight broad backs, rather lighter in bone than some other breeds and shorter in the legs, thus possessing many of the characters of the present-day Devon. They were gentle and hardy, active, and accustomed to gaining their living while roaming over the bleak moors or rocky hills of their rough native country. Here they were known as the "red" cows. They were the main reliance of their owners for dairy products. These mountain-bred cattle were sought after as "feeders" in Devon, Cornwall and Somerset, as well as in Hereford.

Among the early breeders of importance should be mentioned the Quartly and Davy families, through whose efforts the Devons were greatly improved. For several generations the Quartly family devoted themselves to improving the Devons, and Francis Quartly, who began his work in 1793, stands preëminent among Devon breeders. The best blood in the breed has descended from his herd. John Tanner Davy began the improvement of a Devon herd left to him by his father in 1790. On his death in 1852, his son, Colonel Davy, continued his work, and became foremost among Devon breeders of the time. The latter did a great deal to popularize the breed by his writings and by his personal efforts.

In America.—The exact date of the first importations of Devons is uncertain, but it is thought that a few head were brought to America in 1623 by the colonists. Beginning with an importation in 1800 to Massachusetts, several importations were made, the most notable being in 1817, when six pure-bred heifers and a bull were received by Mr. Robert Patterson of Baltimore. The Pattersons made later importations, and were in no small way responsible for the development of the breed in this country. Other breeders imported Devon stock into United States and Canada, but the breed has not become very popular despite the fact that it is worthy.

Distribution.

The Devon cattle are widely distributed, being found scattered through the south of England, in Ireland, South Africa, parts of Australia, Tasmania, New Zealand, the West Indies and in Canada, United States and Mexico. The breed is now represented in every state in the Union with few exceptions, but is most numerous in New England, New York, Pennsylvania, Ohio, Illinois, Wisconsin and Texas. Virginia, Maryland, the Carolinas, Georgia and Alabama each have many herds. It is well adapted to warm climates.

Types.

Two types of Devon cattle have been developed. The North Devon, a hardy, compact type, is probably the original form. The animals are smaller, and have been developed for beef-production primarily. The South Devon, a larger and coarser type, has been developed for both meat and milk, and is now almost a distinct breed.

Uses.

For milk and butter.—While the Devons are not primarily dairy cattle, still some splendid milk-producers have been developed. Although the quantity of the milk-yield is not large, the quality is good, which gives them definite value for

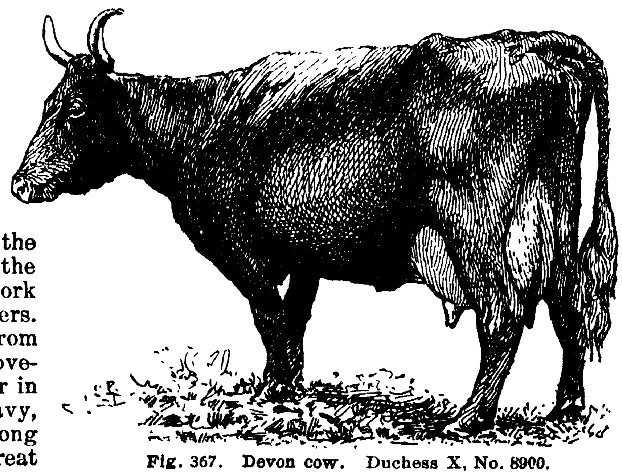

Fig. 367. Devon cow. Duchess X, No. 8900.

butter-making. As a rule they possess well-shaped udders.

For beef.—A chief recommendation of the Devon for beef is that it dresses with little waste, and the meat is of very superior quality. The animals make good gains under stall-feeding but cannot be forced to so great an extent as some of the other beef breeds, and generally are lighter when marketed. The breed is small, which has sometimes militated against it for meat purposes.

For oxen.—The superior intelligence, quick and active movements and great strength of the Devons, render the oxen among the best known and handsomest in the world. Their rapid gait and firm step, together with the ease with which they are trained, have gained for them this superiority.

For grazing.—As grazers, the Devons stand in the first rank, as they are active and hardy, and have been accustomed to rustle on light, hilly pastures.

For crossing.—Prepotency is a characteristic of Devon cattle due to their pure breeding for so long a period. When crossed on grade cows the results are very satisfactory for both meat- and milk-production.

Organizations and records.

In 1851, Colonel Davy issued the first volume of the English Devon Herdbook, other volumes being put out from time to time until 1881, when seven volumes had been published. The Devon Cattle Breeders' Society, organized in 1880, bought the Herdbook in 1884, and has since increased it to nearly thirty volumes. The South Devon Herdbook Society was organized in 1890. It also published a herdbook. The first volume of the American Devon Herdbook appeared in 1863, and in 1879 the fifth and last volume was issued. In 1881, volume one of the American Devon Record was published, six other volumes having appeared since. Yearbooks for 1905, 1906 and 1907 have also been issued. The official organization for the promotion of the interests of the breed in this country is known as the American Devon Cattle Club, with the secretary's office at Newark, Ohio.

Literature.

James Sinclair, History of the Devon Breed of Cattle, London (1893). [For further references, see page 302.]

Dutch Belted Cattle. Figs. 368, 369.

By *Frank R. Sanders.*

Dutch Belted cattle are a dairy breed. Their native home is in Holland, where they are known as Lakenfelds, Lakenvelders or Veldlarkers, which means literally a field of white, but conveys the idea of a white body with black ends.

Description.

In size, these cattle rank about with the Ayrshires, and are also much the same in general conformation, being, if anything, a little larger, and having a little more length of leg. Cows range from 900 to 1,300 pounds in weight. Bulls often weigh 2,000 pounds. The best types of the breed represent a highly developed dairy form, having thin necks, small heads, straight backs, deep chests, hips and rumps high and broad, udders and milk-veins well developed, mellow skin and soft hair, and withal, a high nervous temperament. They are very quiet in disposition. The most distinctive feature of this breed is the very wonderful, pure white belt. This belt when ideal, should be a little back of the shoulder, and a little in front of the hips and should extend entirely around the body in a line-like appearance. The body is coal black, and these combinations of color, so beautifully blended, are the wonder of all who see them.

The following scale of points has been adopted by the Dutch Belted Cattle Association of America.

SCALE OF POINTS FOR DUTCH BELTED CATTLE

For cows	Perfect score
1. **Body**. Color black, with a clearly defined continuous white belt, the belt to be of medium width, beginning behind the shoulders and extending nearly to the hips	8
2. **Head**.—Comparatively long and somewhat dishing; broad between the eyes; poll, prominent; muzzle, fine; tongue, dark	6
3. **Eyes**.—Black, full and mild. **Horns**.—Long compared with their diameter	4
4. **Neck**.—Fine, and moderately thin, and should harmonize in symmetry with the head and shoulders	6
5. **Shoulders**.—Fine at the top, becoming deep and broad as they extend backward and downward, with a low chest	4
6. **Barrel**.—Large and deep with well-developed abdomen; ribs well rounded and free from fat	10
7. **Hips**.—Broad, chine level, with full loin	10
8. **Rump**.—High, long and broad	6
9. **Hind-quarters**. Long and deep, rear line incurving. **Tail**.—Long, slim, tapering to a full switch	8
10. **Legs**.—Short, clean, standing well apart	3
11. **Udder**.—Large, well-developed front and rear; teats of convenient size and wide apart; mammary veins large, long and crooked, entering large orifices	20
12. **Escutcheon**	2
13. **Hair**. Fine and soft; skin of moderate thickness, of a rich dark or yellow color	3
14. Quiet disposition and free from excessive fat	4
15. General condition and apparent constitution	6
Perfection	100

For bulls

The scale of points for males shall be the same as that given for females, except that No. 11 shall be omitted and the bull shall be credited 10 points for size and wide-spread placing of rudimentary teats, and 10 additional points for perfection of belt.

History.

The early history of this breed is not fully understood, but from the records obtainable, and from conversation with several of the oldest breeders in Holland, it seems that these cattle began to flourish about 1750, and no doubt the system of selection

by which this marvelous color breeding was attained, dates back into the sixteenth century. One breeder says his father informed him that there were gentlemen of wealth and leisure near what is now called Haarlem, North Holland, who conceived

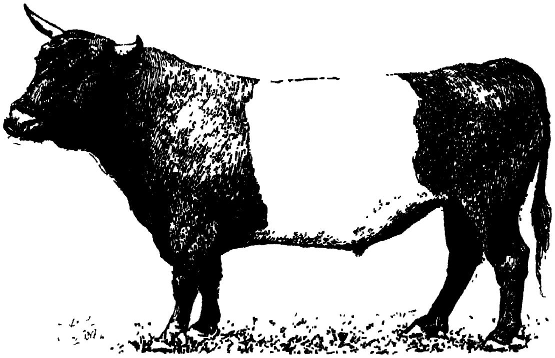

Fig. 368. Dutch Belted bull, Auten, 495. Once champion bull of the breed in America.

the idea of breeding animals of all kinds to a certain color, chiefly with a broad band of white in the center of the body, with black ends. These noblemen had large estates, and it is said that for more than 100 years they and their descendants worked on the perfection of these peculiar color-markings, until they produced belted cattle, pigs, and poultry. That these breeders were wonderfully successful, no one questions, as we have the results of their labors in the Dutch Belted cattle, Lakenvelder poultry of England and America, the Lancheswine of Holland and Germany and the Hampshire swine of America, which were supposed to originate in Hampshire, England, but undoubtedly are the descendants of the Haarlem herds of long ago. All of these breeds possess a belt, and carry out the idea of their originators in a marvelous degree.

The process by which these unparalleled results were attained seems to be hidden in the obscurity of the past ; however, it is not difficult to understand that many years of careful selection might culminate in the desired end. There seems to be some doubt, even in Holland, as to the method employed to produce such distinct color-markings, and nothing in the animal world shows more skill in breeding than the results of the Hollanders in the production of the different breeds, so strongly bred to distinct color lines.

In America.—Dutch Belted cattle were first imported to America in 1838. D. H. Haight was the largest importer. He made his first importation in 1838, and a later one in 1848. His herd became scattered over Orange county, N. Y., until one will find a great many belted cows in every township in that county today. Hon. Robert W. Coleman also imported a large herd to place on his estate at Cornwall, Pa. The Dutch Belted cattle in America today are entirely descended from these herds. In 1840, P. T. Barnum imported a number of Dutch Belted cattle for show purposes, but shortly placed them on his farm in Orange county, New York. One heifer was imported in 1906 by Dr. H. W. Lance, of New York City, for his farm in New Jersey, but previous to that time none were brought over for more than fifty years. This was due chiefly to the very great difficulty in securing them and to the restriction against importing them. A number have been exported from this country to Canada and Mexico, and a few to Cuba. In 1893, H. B. Richards, secretary of the Dutch Belted Cattle Association, sold his World's Fair herd, numberbering sixteen, and nine others to a son-in-law of President Diaz and shipped them to Mexico. Later, Mr. Richards sold twenty to Sir William Van Horne, of Canada. Other exportations have been made. There are about fifteen hundred head in America at the present time.

Distribution.

Dutch Belted cattle are not widely distributed, but are found in comparatively small numbers in Holland, Canada, United States and Mexico. In America the largest herds are found in the New England States and New York. The cattle are also found in Pennsylvania, New Jersey, Ohio, Mississippi and other parts of the South, and several fine herds are being built up on the Pacific coast.

As many of these cattle have been kept successfully in northern New England for years, they have gradually assumed a hardy constitution, well adapted to withstand New England climates. There also seems to be a place for them in hilly sections, as they are active and well able to rustle.

Feeding.

These cattle do best on a comparatively light grain ration, usually not over eight pounds in a properly balanced ration. When fed heavy they

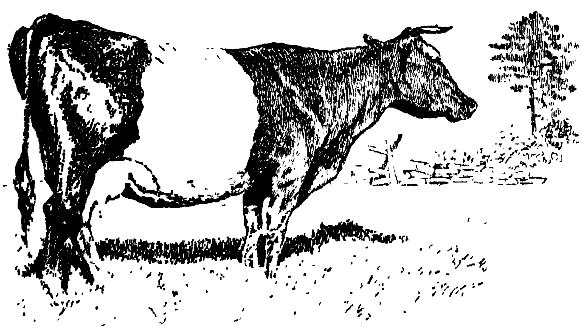

Fig. 369. Dutch Belted cow, Echo, II, 701.

return a less per cent of profits. This is a reason, also, why Dutch Belted cattle do well in sections of country where feed is not abundant.

Uses.

For milk and butter.—Dutch Belted cows, as a rule, are large, persistent milkers, giving milk constantly, almost without going dry. The fact that we have many breeders of fifteen, twenty and twenty-five years experience who are as enthusiastic as ever, speaks strongly of the merits of the breed. In order to convey an idea of the ability of

this breed in the production of milk and butter, we cite the records of the cows of some of the breeders for long periods. Mr. J. A. Holbert, of New York, at one time had a fine herd of Dutch Belted cattle and he kept a careful record for over eight years. Twenty-five of his cows and heifers averaged about 9,000 pounds yearly, fed eight pounds of grain and hay ad libitum in winter and pasture alone in summer. Mrs. S. A. F. Servin, one of the largest breeders, who has maintained a farm solely for profit, kept a daily record for eleven years, and twenty-five cows averaged between nine and ten thousand pounds of milk yearly. Mr. D. B. Wilson of Connecticut, who has made butter from his herd for about twelve years, says that it takes about ten quarts of milk to make a pound of butter. Cows in the Mountain Lawn Herd of New Hampshire, owned by the writer, have averaged as follows: Eleven cows made an average of 8,579 pounds of milk for eight years. One cow produced 12,672 pounds of milk in one year and in six years 60,297 pounds. The average production of butter by this cow was 596 pounds yearly.

For beef.— Because of their scarcity, Dutch Belted cattle are seldom offered for beef. Owing to their size and easy keeping qualities, they make good beef, and rank well with the other dairy breeds.

For ornament. —This breed of cattle has a use for ornamental purposes. Because of their unique appearance and beauty, they are constantly sought by persons of wealth who desire something novel as well as useful.

Diseases.

It has been shown by the experience of a number of breeders that Dutch Belted cattle are exceptionally free from disease, and need no special care.

Organizations and records.

The Dutch Belted Cattle Association of America was organized February 4, 1886, in New York City, and is the only organization promoting the breed in America. The Netherland General Stamboek, published at the Hague, Holland, is the foreign representative. Eight herdbooks of the Dutch Belted Cattle Association of America have been published to date. The address of the secretary is Easton, Pa.

Literature.

For references, see page 302.

French-Canadian Cattle. Figs. 370, 371.

By *G. E. Day.*

French-Canadian cattle, or "Quebec Jerseys" as they are sometimes called, belong to the strictly dairy class. They are an American breed, developed in Canada.

Description.

French-Canadian cattle are somewhat small, mature cows weighing 700 to 900 pounds and bulls about 1,000 pounds. The rules for registration contain the following statements regarding color: "The color for cows may be black or brown, or dark brown, with or without a yellow stripe along the back and around the muzzle, or a gray stripe around the muzzle. The color may also be fawn or brindle. The color for bulls may be black or brown, or dark brown with or without a yellow stripe along the back and around the muzzle, or a gray stripe around the muzzle. Registration should not be refused if females have a little white under the belly, on the forehead, or in the switch, nor to bulls having a little white under the belly or in the switch. The horns must be white with black tips or black with white tips." In general appearance they resemble the Jersey, but have less of the deer-like appearance possessed by the Jersey, and are somewhat more rugged in appearance. The type is lean and muscular, and the cows tend to be wedge-shaped.

The scale of points which follows was prepared by The French-Canadian Cattle Breeders' Association of Canada.

Scale of Points for French-Canadian Cattle

For cows

	Perfect score
1. **Dairy temperament** (25)	
Head.—Lean, long, feminine and refined in appearance	3
Neck.—Thin, rather long, ewe-necked	3
Shoulders.—Light and spare, withers sharp	3
Crops.—High, straight and sharp	3
Spine and ribs.—Spine prominent, vertebræ and ribs open spaced	3
Thighs.—Thin and incurving, flank high	5
Hip joints and pin-bones.—Sharp, angular	2
Pelvic arch.—Prominent, strong and sharp	2
Tail.—Long and tapering	1
2. **Feeding powers** (25)	
Barrel.—Depth from line of back to navel	10
Length of body from shoulder to hook-points	7
Breadth of body through middle	6
(Period of gestation to be considered).	
Muzzle.—Broad, jaw strong	2
3. **Mammary organs** (25)	
Udder.—Long, broad and deep, extending well forward and well up behind; well let down, but not pendulous; all quarters fully and symmetrically developed; fine and elastic; not fleshy; teats well placed and wide apart	15
Teats.—Rather large, equal in size, not cone-shaped	2
Milk-wells.—Numerous, large and far forward	4
Milk veins and veins on udder.—Prominent and branching. (Age to be considered.)	3
Escutcheon.—High and wide, with thigh ovals	1
4. **Disposition** (5)	
Eyes.—Large, prominent, bright, intelligent and placid	3
Face.—Broad between eyes	1
Movement of ears and body.—Rather slow, not restless	1
5. **Quality** (5)	
Skin.—Loose, thin, mellow, with fine soft hair	3
Skin.—Deep yellow in ears and on and around escutcheon	2
6. **Constitution** (5)	
Chest.—Deep; wide through heart, full behind and a little above elbows; large girth of chest	3
Nostrils.—Large, open	1
Loin—Broad	1

Scale of Points for French-Canadian Cattle, continued

For cows	Perfect score
7. **Symmetry** (4)	
Horns.—Not large nor coarse, curved, black or black with white tips, or vice versa	1
Legs.—Rather short, straight and well placed	1
Color.—Black or dark brown, preferably with brown, fawn or cream-colored muzzle, and brown, fawn or yellow stripe on back	2
8. **General appearance,** including style and movement	6
Perfection	100

For bulls the score is the same except in the following points : The head should be masculine in appearance, and of fine contour ; neck muscular and somewhat arched, proud and vigorous in bearing ; for crops, allow 2 points ; spine less prominent than in cow ; for thighs, allow 3 points ; no score for hip joints and pin-bones ; omit section 3 ; under section 5 (quality), allow 6 points for first caption (quality of skin), and 4 points for second caption (color of skin); under section 6 (constitution), allow 6 points for chest, 2 points for nostrils and 2 points for loins ; under section 7 (symmetry), allow 2 points for legs and 10 points for color; for caption 8 (general appearance), allow 12 points. Add a section on "Dairy Indications" (5), as follows : Embryo teats,—not less than four well-developed embryo teats, well forward and wide apart, with amplitude of skin on rear part of under-line—3 points ; escutcheon,—high and wide—2 points.

History.

French-Canadian cattle are undoubtedly descended from cattle brought to Canada from Brittany and Normandy by the early French settlers, between the years 1620 and 1650. They are thought, therefore, to be of the same origin as the Jersey and Guernsey, and their appearance testifies to the truth of this opinion. Although the climate of the province of Quebec, where these cattle were brought by the settlers, is much more severe than that of their native land, these little cattle showed wonderful adaptability to changed circumstances, and appear to have thriven under a rigorous climate, cold stables, coarse fare, and very indifferent care and management. The result is a breed that is second to none in hardiness ; and it is said that it is a very rare thing for an animal of this breed to be affected with tuberculosis.

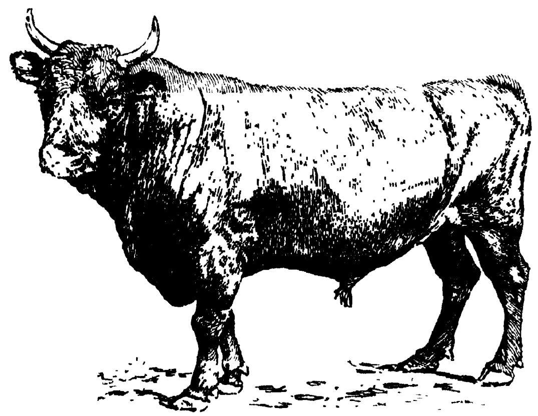

Fig. 370. French-Canadian bull. Denis Albert No. 1477.

Distribution.

As might be expected, the headquarters for this breed is the province of Quebec, where they are popular with the French-Canadian farmer, or "habitant." It is only within comparatively recent years that the breed has become known to the outside world. The entering of five cows in the Pan-American dairy test, where they gave a remarkably good account of themselves, served to advertise the breed more than any other circumstance, and they are now to be found in several states of the Union, as well as in the provinces of Ontario, New Brunswick, Nova Scotia, and Prince Edward Island. They have also established themselves on the island of Anticosti. These cattle should prove of value on the hills of northeastern United States, especially in New England, New York and Pennsylvania. As yet, however, the number of herds outside of Quebec is comparatively small, and it is difficult to say just how far these hardy little cattle may extend their domain.

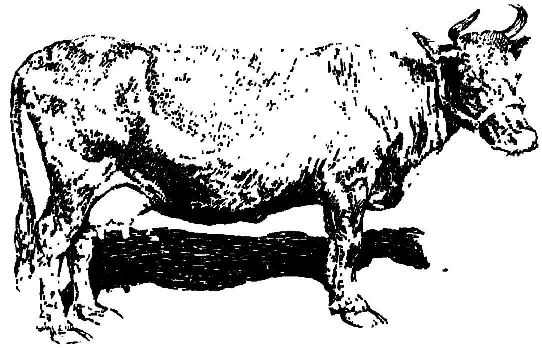

Fig. 371. French-Canadian cow. Denise Championne. No 6247.

Management.

One of the most remarkable things about French-Canadian cattle is the degree of excellence as dairy cattle which they have retained under generations of unskilled selection, bare pastures in summer, and, as a rule, a winter ration of nothing but straw. But they respond readily to more liberal treatment. The application of well-known principles of breeding, and the following of a judicious system of feeding, should render the French-Canadian a really prominent dairy breed.

Uses.

For milk and butter.—The French-Canadian is a strictly dairy breed. As yet, milk and butter records for the breed are not very numerous. Generally speaking, in quantity and quality of milk they resemble the Jersey. At the Central Experimental Farm, Ottawa, Ontario, in 1903, a French-Canadian cow made more butter and gave a larger profit than any other pure-bred cow in the herd, including Ayrshires, Guernseys and Shorthorns. In 1904, in the same herd, three French-Canadian

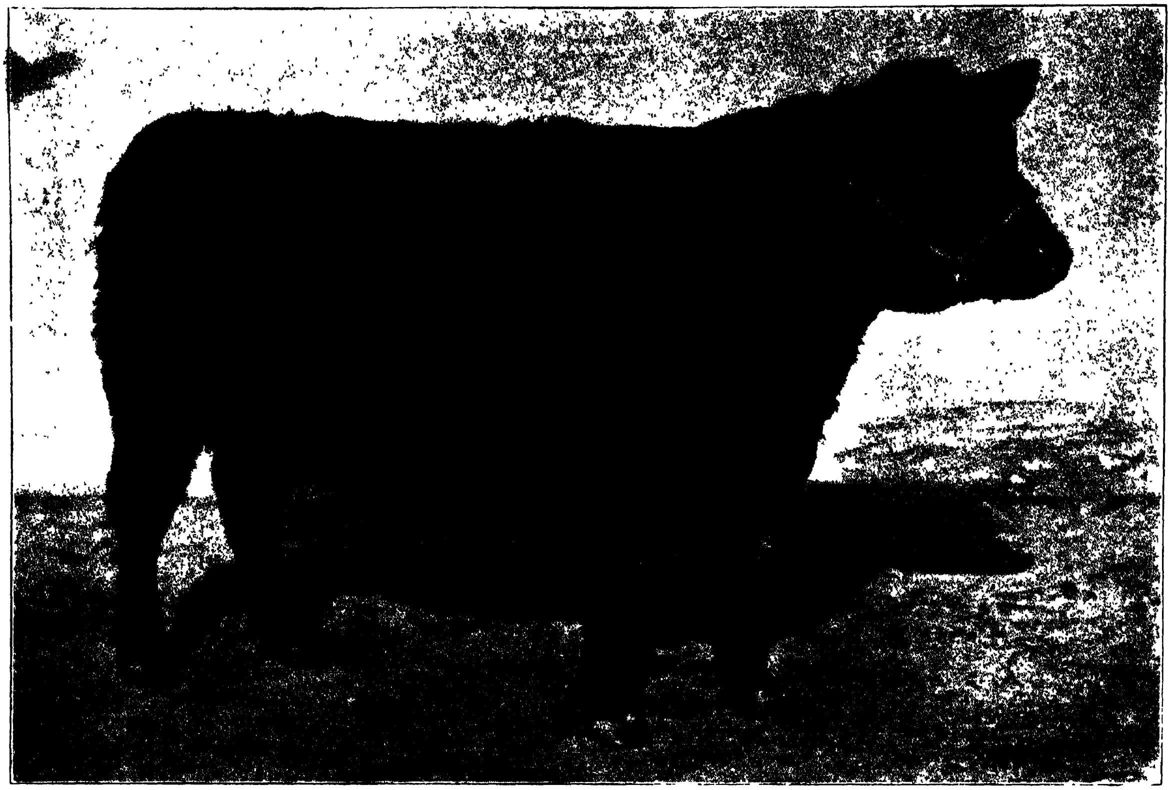

Plate X. Galloway cow and Guernsey bull

cattle made more butter and gave a larger profit than the three best cows of any other breed, including Ayrshires, Guernseys and Shorthorns. The yearly product per cow of these three cows was 8,340 pounds of milk, testing 4.52 per cent, or 442.64 pounds of butter. The total yearly profit per cow above cost of feed was $56.24. In the Pan-American test, the five French-Canadian cows stood sixth in total profits from butter and gain in weight, but in percentage of profit on value of food, they led all breeds. Recently, a record of performance has been established in connection with the breed, and the first cow to qualify under the rules produced in eleven months, 7,488 pounds of milk, and 332.8 pounds of butter-fat. It will be seen, therefore, that the French-Canadian cow possesses dairy qualities of no mean character.

For beef.—This breed has little claim to beefing qualities, and has comparatively little value from the point of view of the beef advocate.

For crossing.—The use of the French-Canadian bulls on native cows should be especially appropriate in the Northeast, where dairying is a specialty, and no doubt the offspring would show increased vigor over the dams, and in many cases the cows would yield milk richer in butter-fat.

Organizations and records.

The first organization in the interests of French-Canadian cattle was formed in 1886, and a record was established to record foundation stock. The record was placed in the hands of a commission appointed by the Quebec government. In 1895, this record was handed over to the French-Canadian Cattle Breeders' Association, organized by Dr. J. A. Couture, Quebec, who is still secretary of the Association. In 1896, the Foundation Herdbook was closed, and since that time only the progeny of recorded animals have been accepted for registration. In the Foundation Herdbook there were recorded 5,307 females, and 922 males. In 1905, the old "French-Canadian Cattle Book" was taken over by the Canadian National Live-Stock Records. No herdbook has yet been issued.

Literature.

For references, see page 302.

Galloway Cattle. Figs. 372, 373.

By *Charles Gray.*

The Galloway is a breed of beef cattle which derives its name from the province of Galloway, which is now confined to the two southwest counties of Scotland, but formerly comprised the six counties lying south of the Firth of Forth. The name Galloway now embraces only the Stewartry of Kirkcudbright and the shire of Wigton.

Description.

The typical modern Galloway is a low, blocky animal, with a long, soft, shaggy coat of black hair, hornless, well sprung in the ribs, the whole make-up resembling a barrel in shape, which is evenly covered with juicy, lean flesh. The Galloways have been hornless from time immemorial. Some writers mention a tradition to the effect that in remote ages they were provided with horns; however, notices of the breed centuries ago invariably state that Galloways were hornless. If any so-called Galloway presents the slightest appearance of horns he should be rejected as impure.

The following scale of points, adopted by the American Galloway Breeders' Association, December 22, 1905, shows the characters to be desired in the best type. The numerical values attached to the development of each part are not given.

Scale of Points for Galloway Cattle

1. **Color.**—Black, or black with a brownish tinge; white markings on feet, ankles or legs, or on any part of the body above the under-line are very objectionable.
2. **Head.**—Short and wide; forehead broad; crown wide and oval, not rising to a point; any trace of scurs or horns debars an animal from registration. Face clean, muzzle broad, and nostrils large.
3. **Eye.**—Large and prominent.
4. **Ear.**—Moderate in length and broad, pointing forward and upward, with fringe of long hair.
5. **Neck.**—Short, clean, and filling into the shoulder in such a way as to make the neck and shoulder of fleshy animals appear molded as one piece; the top of the neck in line with the back in a female, and in a male rising with age.
6. **Body.**—Deep, wide, well rounded, moderate in length and symmetrical.
7. **Shoulders.**—Broad, but well laid into body, joining smoothly; compact and deeply fleshed on top.
8. **Ribs.**—Deep and well sprung; crops deeply fleshed, making width of shoulders and body at ribs uniform.
9. **Hook bones.**—Not prominent; in fleshy animals not visible.
10. **Loin.**—Moderate in length, wide and deeply fleshed.
11. **Hind-quarters.**—Long, wide and well filled.
12. **Rump.**—Straight, wide, carrying width of body out uniformly; well filled with flesh.
13. **Thighs.**—Broad as viewed from side, thick as viewed from behind; straight and well let down at hock; rounded buttocks very objectionable.
14. **Legs.**—Short and clean, with fine bone.
15. **Tail.**—Set on straight and smoothly laid in with flesh at sides; high tail-head very objectionable.
16. **Skin.**—Mellow and moderate in thickness.
17. **Hair.**—Soft and wavy, with mossy undercoat; harsh or wiry hair is very objectionable; curly hair, if soft, is not objectionable.

History.

The origin of the Galloway cattle is lost in the mists of antiquity. When the Romans first visited Britain the country was covered with dense forests. In these forests the Romans found many wild cattle roaming at their leisure, and it is now conceded that they were the progenitors of our modern breed of Galloways. Cattle-breeding has been the principal business among Galloway farmers since time immemorial. A history of Scotland alluding to the time prior to and including the reign of Alexander III (1249) says: "Black cattle were reared in great numbers during the Scoto-Saxon period." George Buchanan, tutor to James I, of England, writing about 1566, says of Galloway: "It is more fruitful in cattle than in corn."

The breed was of great importance during the Scoto-Saxon period. In the early ages the dairy was an object of considerable attention. Large quantities of cheese were made and the people consumed much animal flesh. There was also an extensive export trade in hides. At a later period, immediately after the union of England and Scotland, the farmers of England became extensive purchasers of Galloway cattle. During this activity the Galloways found much favor among the graziers of the south of England and the butchers of Smithfield market, and they invariably sold at an average price of £2 per head above that of any other breed of the same weight. The breed was much improved during this period and later when turnip husbandry was introduced into the province of Galloway. A circumstance worthy of attention is that the breed has never been affected by crossing with any other breed. The improvement has been brought about entirely by the diligent attention and careful management of the breeders of Galloway and of the corn-belt of America.

Although the Galloway is the oldest of the pure breeds of Britain, there has been very little written about the breed, and the records that were collected during the early part of the last century were destroyed by fire in the Highland and Agricultural Society's Museum and Records in Edinburgh in 1851. Some time later, about the year 1862, a book of pedigrees was compiled, which contained pedigrees of both Aberdeen-Angus and Galloways. Still a little later, about the year 1878, the Galloway Cattle Society of Great Britain, with the able assistance of the secretary, Rev. John Gillispie, of Dumfriesshire, Scotland, published the first book of Galloway pedigrees which we have and which is recognized by Galloway associations at present.

In America.—The breed was formally introduced into America by an importation made by Graham Brothers, Ontario, Canada, in 1853, although it has been said that one or two individuals were seen in

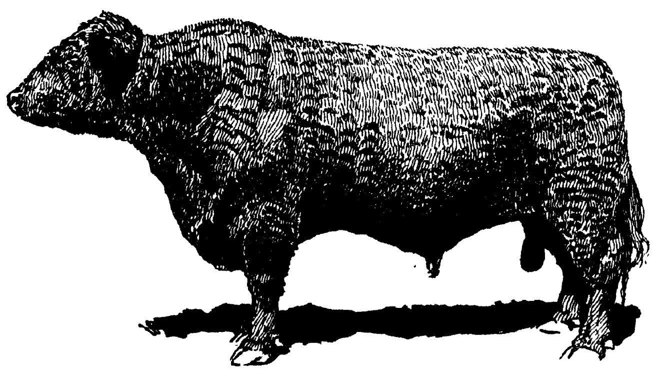

Fig. 372. Galloway bull. Pat Ryan of Red Cloud 20038.

this country before that time. The cattle of the first importation adapted themselves so readily to Canadian conditions that many large shipments quickly followed, until now the hornless, shaggy blacks are found in all the provinces of Canada and nearly every state in the Union. The breed made its way into the United States slowly at first. A few head were brought into Michigan in 1870, and from there spread into other central and western states.

Distribution.

Galloways are found mainly in Scotland, Canada and the United States, but have been exported to

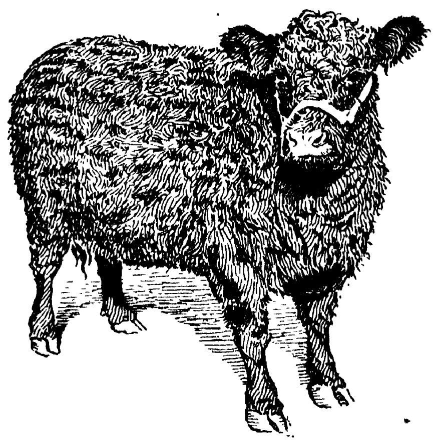

Fig. 373. Galloway cow. Myrtle of Avondale 24912

several countries. They can now be found in Russia, South Africa, Mexico and Alaska. In United States they are more numerous in the corn-belt and western range states than in the southern states. In the past year several have been shipped to Virginia, Florida, California and Alaska from the corn-belt herds, and an enterprising Spaniard has recently taken a large number from Midland, Texas, to his ranch in Mexico.

Uses.

For milk.—The Galloways, as a breed, can not lay claim to any superiority as milkers. Although many herds have keen kept for centuries in the south of Scotland for dairy purposes, yet, as a whole, the breed has been improved chiefly along the lines of beef-production. Some breeders in Scotland have developed the milking faculty of their herds to a very high degree by systematically disposing of cows that proved shy milkers. It is not an uncommon thing in the corn-belt of this country to find cows that produce large quantities of milk. Some of the most noted show-cows exhibited in recent years gave large quantities of very rich milk during their milking season. Many persons think that Galloways are useless as dairy animals, but this is erroneous. The United States Government recently purchased a number of animals of the milking strains and sent them to Alaska for dairy purposes. Many favorable reports have been received from Alaska since these hardy blacks arrived at their new home. They seem to be as well adapted to the rigors of the northern climate as they are to the inclement

weather found among the rugged hills and fertile glens of their native land in southwestern Scotland.

For beef.—It is chiefly as a beef-producing breed that the Galloways are famous. The quality of their beef attracted much attention in the British markets centuries ago, and had the distinction of being classed as "prime scots" at Smithfield long before these animals were known to the feeders of the corn-belt or the cow-men of the western plains. The superiority of the Galloway beef arises from the fact that it is always well marbled and possesses a large proportion of lean meat intermixed with fat. The packers and butchers have been striving to educate breeders, stockmen and farmers to breed animals with a greater proportion of natural flesh and less wasteful fat. The Galloway has long been bred with this essential feature in view, and thus he leads his rivals in this respect, and brings higher returns per hundred pounds live weight.

The breed has been vastly improved since its introduction into the corn-belt. Greater weights have been secured in shorter time than was customary twenty-five years ago, and the early-maturing feature has been much in evidence. In the past, the statement has been advanced by some persons that one could not mature the Galloways so soon as individuals of other beef breeds. One need only visit some of the leading Galloway herds throughout the country, or review the various ages and classes of individuals presented every year at the national shows, to be convinced of the error of this statement. Experienced authorities who have handled two or more of the leading beef breeds under similar conditions maintain that the Galloways mature at any age just as readily as individuals of any other beef breed. Today, the Galloways have many claims to favoritism. Experiments at various agricultural experiment stations show that while they do not attain so great size as some of the other beef breeds, yet they are more economical feeders, especially where a large proportion of roughage has to be consumed. When the numbers of each breed is considered, the Galloways top the market at the great live-stock centers as often as any other breed. The killing qualities are in their favor because, as a rule, the Galloways have very little waste offal or fat that sloughs off, and consequently, they dress a very high percentage of marketable beef.

For hides.—In midsummer the hide of the Galloway has no greater comparative value than that of any other breed. From November to March, however, when the coat of hair is long and at its best, the Galloway hide is worth five to eight cents per pound more than the hide of an animal of any other breed. There was a time when the Western plains were covered with buffalo, which produced millions of robes, but these animals are now almost extinct, and the Galloway is the only domestic animal of the bovine race that can roam on the plains and produce a superior quality of beef and robes that can take the place of the buffalo of days gone by.

For grazing.—As grazers, the Galloways are seldom equaled and never excelled. It has already been mentioned that the habitat of the Galloway was for centuries in the southwest of Scotland. They were often kept on the hills where the pasture was scant, and they invariably gave a good account of themselves. They respond readily to the luxuriant pasture of the valleys, but thrive and seem contented on the bleak, scant forage of the moorland. For a time they had a struggle for existence in this country, due to the keenness of their worthy rivals of the other beef breeds. Their persistent struggles and many victories in the show-yard in recent years, however, have established a place for them in the corn-belt and the ranges of the West and Southwest, which will undoubtedly continue as long as our cattle industry remains. The constitution which was built up from years of exposure to inclement weather in Scotland furnishes the breed with the required merits, and readily recommends them for the vast grazing ranges of the Northwest, West and Southwest. In summer on the range, the Galloway will make as good gains on luxuriant pasture as any breed, and will hold his own and often thrive on scant pastures or on drouth-stricken regions where cattle of other breeds can not exist. While the hardy constitution is put forward as a special merit, however, one should not forget that Galloways prefer luxuriant feed just as much as the softer breeds, and will give increased returns from good feed and care.

On the range where different breeds have been wintered it has been found that during severe storms the mortality among Galloways is much less, and the loss in weight due to disagreeable weather much smaller, than is usually in evidence among individuals of the softer breeds.

The Galloway calves are very active and hardy when dropped on the open range, and are soon able to rustle for themselves. In summer they can endure the broiling sun and in winter withstand the severest storms.

For crossing.—For prepotency, this breed stands in the first rank. It is conceded that the Galloway possesses the ability to perpetuate himself as uniformly in size, quality and color as any other breed. The stockman must have a uniform bunch of hornless steers in order to command top prices. By the use of a good Galloway bull on average cows the best results are invariably secured. The Galloway as a dehorner stands high among the polled breeds. In this day when practically all feeding cattle are dehorned, the naturally polled cattle have a decided advantage over their horned rivals, as the dehorning process is many times dangerous and occasionally fatal, and in every instance it causes a temporary shrinkage in weight and tardiness in growth of animals.

For crossing with other breeds, especially with the Shorthorns, they are very valuable. The outcome of the cross of Shorthorn bulls on Galloway cows is usually known as "blue-grays." This system of crossing has been practiced for many years in Great Britain and to some extent in this country, and the results have been very satisfactory. The Shorthorn furnishes plenty of size, while the Galloway forms the low type and large proportion

of natural flesh, qualities which up-to-date feeders and butchers are constantly demanding. When a pure-bred animal is crossed on any grade beef or dairy cow, the results are surprising and the offspring is invariably hornless, black in color and uniform in make-up. Galloway bulls are used very freely in the dairy districts of Great Britain, and the black calves sell at much better prices than those from bulls of the dairy breeds.

Organizations and records.

The Council of the Galloway Cattle Society of Great Britain, Mouswald Manse, Ruthwell, R. S. O., Dumfriesshire, Scotland; the Dominion Galloway Register of Canada, Ottawa; and the American Galloway Breeders' Association, 17 Exchange Avenue, Chicago, Illinois, are the present representatives of this breed. About 1872, there was established the Ontario Galloway Stock Register of Pure Bred Galloways. The North American Galloway Herdbook, the official record of the American Association, was first published in 1883. Fifteen volumes had been published up to 1905. [See further notes on page 346.]

Literature.

For references, see page 302.

Guernsey Cattle. Figs. 374, 375.

By *William H. Caldwell.*

The Guernsey is one of the leading breeds of dairy cattle.

Description.

The following scale of points, adopted by The American Guernsey Cattle Club, December 13, 1899, together with the explanatory notes by the committee, describes what is desired in the Guernsey:

SCALE OF POINTS FOR GUERNSEY CATTLE

For cows	Perfect score
1. **Dairy temperament. Constitution** (38)	
Clean-cut, lean face; strong, sinewy jaw; wide muzzle, with wide open nostrils; full, bright eye, with quiet and gentle expression; forehead long and broad	5
Long, thin neck, with strong juncture to head; clean throat. Back-bone rising well between shoulder-blades; large, rugged, spinal processes, indicating good development of the spinal cord	5
Pelvis arching and wide; rump long; wide, strong structure of spine at setting-on of tail. Long, thin tail with good switch. Thin, incurving thighs	5
Ribs amply and fully sprung and wide apart, giving an open, relaxed conformation; thin, arching flanks	5
Abdomen large and deep, with strong muscular and navel development, indicative of capacity and vitality	15
Hide firm, yet loose, with an oily feeling and texture, but not thick	3
2. **Milking marks denoting quantity of flow** (10)	
Escutcheon wide on thighs; high and broad, with thigh ovals	2

SCALE OF POINTS FOR GUERNSEY CATTLE, continued

For cows	Perfect score
Milk veins long, crooked, branching and prominent, with large or deep wells	8
3. **Udder formation** (26)	
Udder full in front	8
Udder full and well up behind	8
Udder of large size and capacity	4
Teats well apart, squarely placed, and of good and even size	6
4. **Indicating color of milk.**—Skin deep yellow in ear, on end of bone of tail, at base of horns, on udder, teats and body generally. Hoof amber-colored	15
5. **Milking marks denoting quality of flow.**—Udder showing plenty of substance, but not too meaty	6
6. **Symmetry and size** (5)	
Color of hair a shade of fawn, with white markings. Cream-colored nose. Horns amber-colored, small, curved and not coarse	3
Size for the breed:—Mature cows, four years old or over, about 1,050 pounds	2
Perfection	100

For bulls	Perfect score
1. **Dairy temperament. Constitution** (38)	
Clean-cut, lean face; strong, sinewy jaw; wide muzzle, with wide open nostrils; full, bright eye, with quiet and gentle expression; forehead long and broad	5
Long, masculine neck, with strong juncture to head; clean throat. Back-bone rising well between shoulder-blades, large, rugged, spinal processes, indicating good development of the spinal cord	5
Pelvis arching and wide; rump long; wide, strong structure of spine at setting-on of tail. Long, thin tail with good switch. Thin, incurving thighs	5
Ribs amply and fully sprung and wide apart, giving an open, relaxed conformation; thin, arching flank	5
Abdomen large and deep, with strong muscular and navel development, indicative of capacity and vitality	15
Hide firm, yet loose, with an oily feeling and texture, but not thick	3
2. **Dairy prepotency.**—As shown by having a great deal of vigor, style, alertness, and resolute appearance	15
3. **Rudimentaries and milk veins.**—Rudimentaries of good size, squarely and broadly placed in front of and free from scrotum. Milk veins prominent	10
4. **Indicating color of milk in offspring.**—Skin deep yellow in ear, on end of bone of tail, at base of horns and body generally; hoofs amber-colored	15
5. **Symmetry and size** (22)	
Color of hair a shade of fawn, with white markings. Cream-colored nose. Horns amber-colored, curving and not coarse	8
Size for the breed:—Mature bulls, four years old or over, about 1,500 pounds	4
General appearance as indicative of the power to beget animals of strong dairy qualities	10
Perfection	100

Explanatory Notes by Committee

"We recognize that the Guernsey should be—

(1) A dairy animal with a distinctive dairy temperament and conformation, having a strong, nervy structure with a corresponding flow of nervous energy, and every indication of capacity and vitality.

(2) In color of hair, a shade of fawn, with white on limbs and under part of body, are considered the prevailing markings, and some degree of uniformity is desirable.

(3) One of the important distinguishing features of the breed is the presence of a yellow color in the pigment of the skin, which is indicative of rich golden color in the milk. This is very pronounced in the Guernsey and held by her to the greatest extent under all conditions of stabling and feed. The intensity of this trait is more marked in some animals and families than in others, but it should be kept at the highest standard. It is fast being recognized that this color is accompanied by a superior flavor in the milk and thus in the butter.

Dairy temperament

"By 'dairy temperament' is meant a strong, overruling pre-disposition or tendency to turn the consumption of food towards the production of milk with a high content of solids, especially butter-fat, as against the constitutional tendency, so often seen, to turn food into flesh. Even in the strongest dairy breeds there are more or less frequent out-crops in male and female of the flesh-making temperament. To breed from such animals, while we are striving to establish a prepotent dairy temperament or tendency, is not wise. All cattle bred specifically for dairy purposes should possess a clear and decided dairy temperament, for it is that quality of character we most desire to establish, enlarge and perpetuate in the Guernsey cow.

"This is especially indicated by the shape of the head, showing brain capacity, wide muzzle, open nostril, full, bright eyes, feminine neck, and a construction of the backbone indicating a strong flow of nerve-power and support from the brain to all of the maternal organs.

Constitution

"In breeding our domestic animals, especially for long service like the dairy cow, it is very important that they should have abundant vital power, which we call 'constitution.' But constitution must be judged and measured by the peculiar function the animal is bred to fulfil. With the race-horse the function is speed; with the steer, the laying on of flesh; with the dairy cow, the production of milk solids. In all these various functions, the animal that is to represent any one of them must show not only large capacity in the line of that function, but also the ability to endure long and well the strain of such function, and keep in good health. Constitution is best indicated by a full development at the navel, and strong abdominal walls, showing that the animal, when in a prenatal state, was abundantly nourished by the mother through a well-developed umbilical cord.

Prepotency

"In the scale for bulls, for the first time, we believe, in the history of dairy breeds, this point is introduced. The reason we have included it is that 'prepotency' is the chief consideration in the selection of a male breeding animal. The pedigree and conformation is often all that can be desired, but because the bull is lacking in prepotent breeding power he is an expensive failure. This quality is, in a sense, difficult to perceive or describe, but we know certain animals have it in high degree and others fail of it completely. It is fairly well indicated by vigor of appearance, strong resolute bearing and abundant nervous energy. We would distinguish this from an ugly disposition. A bull is ugly by the way he is handled rather than by his breeding. What we want is strong impressive blood. A dull sluggish spirit and action, we consider indicative of a lack of true dairy prepotency, but we would prefer to breed to a rather sluggish-appearing bull with first-class rudimentaries than to a stylish one with badly placed rudimentaries.

Rudimentary teats

"We consider that a well-balanced and well-shaped udder in the cow is largely due to the way the rudimentary teats are placed on the sire. If they are crowded close together the result is likely to be narrow, pointed udders. If they are placed well apart, of good size and well forward of the scrotum, the effect, we think, will be to influence largely the production of well-shaped udders in the resulting heifers, and counteract the tendency to ill-shaped udders inheritable from dams deficient in this respect. We believe the future excellence of the Guernsey cow will be greatly aided by close attention on the part of her breeders to this point."

The temperament of both the bulls and cows of this breed is very quiet and uniform. The bulls are very tractable and the cows have been developed and handled on the Island in a way that would indicate gentleness and quietude.

History.

The Guernsey breed of cattle originated and was developed on the island of Guernsey, which is one of the Channel islands. The foundation of the breed lay in the admixture of the large, red Normandy, and the little black Brittainy breeds, which were brought from the neighboring coast of France to the Island. It has been generally accepted that the large red Normandy males predominated in crossing on the little black Brittainy cows on Guernsey, and that the Guernsey takes many of its characteristics from the Normandy breed. The fact that for nearly one hundred years no live cattle have been permitted to come on the Island, is enough to say that the breed has remained pure, and been bred by itself without admixture of foreign blood. The Royal Guernsey Agricultural and Horticultural Society is largely responsible for the improvement of the breed.

Little more can be said of the history of the breed on the Island. The shrewd, careful, sturdy islander, while zealously guarding the purity of the breed, paid little attention to the breeding and development of his cattle. In fact, on the Island, the glasshouse and bulb industry supplanted that of the cows in the islander's mind. The cattle were never bred to the dictate of fashion, but developed by themselves into a hardy, sturdy breed, commonly spoken of as "the old-time yellow and white cow—the farmer's cow."

In America.—In 1818, a pair of cattle were secured from the island of Alderney, by Reuben Haines, of Germantown, Pennsylvania. These may have been Guernseys. The first definite record of importation of Guernseys into this country was about 1833, when a sea captain, stopping at the island, brought to this country a pair of

young animals that were sent to his brother on what is known as Cow island, in Lake Winnepesaukee, New Hampshire. Traces of this importation are still to be found in some Guernseys in that state. Guernseys were introduced into private dairies around Philadelphia as early as 1840, and are still to be found in the dairies of some of those families who first introduced them there. About 1865, a few Guernseys were brought over by the Fowlers, who were importing Jerseys, and in some herds animals can be traced to the importations of that period. In June, 1871, Mr. James M. Codman, now President of the American Guernsey Cattle Club, selected eight cows and a bull on the island of Guernsey, and imported them. These few cows made a high reputation for themselves, and a number of owners of gentlemen's estates near Boston were attracted by their merits. This led the Massachusetts Society for Promoting Agriculture to send, in 1874, one of their members to import a herd, which was maintained by the Society for a short time, and then sold at auction to its members. This was followed by a number of Connecticut farmers joining together, and sending a representative to the Island to bring over a shipment. These importations laid the foundation of the Guernsey in this country, and led to the establishment of the herd register.

The first real public introduction of the breed was in connection with the dairy test conducted by the New York and New Jersey Agricultural Experiment Stations, when the various breeds were tried, and the Guernsey made a most creditable record, the figures showing them to be the most economical producers of cream and butter, ranking the lowest in cost of food to produce a pound of butter-fat, and in the cost of food for maintenance for a year. The Guernseys and the

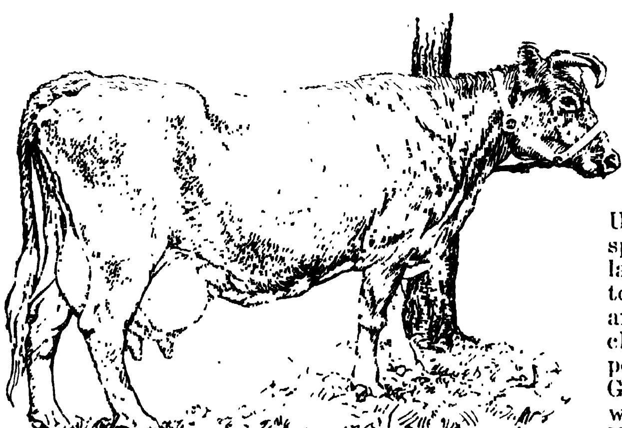

Fig. 375. Guernsey cow. Sultana of Paxtang 8732. Advanced Registry No. 28.

sister Channel island breed (the Jersey), stood first in the annual production of butter, and the profit resulting from sale of cream. Their next appearance was at the World's Columbian Exposition at Chicago, in 1893, where amidst rules and conditions which failed to credit the breed fully on some of its special characteristics, yet the Guernseys ranked ahead on flavor and had the advantage on color of butter, and, as in the Experiment Station trials, stood with the Jerseys in the front rank as butter-producers. The last public appearance of the breed was at the Pan-American Exposition at

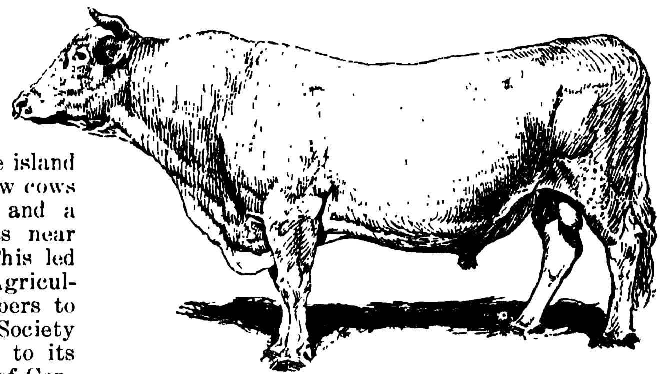

Fig. 374. Guernsey bull. Benjamin 1931 Advanced Registry No. 2

Buffalo, where after a careful six months' test, the Guernseys were awarded the first prize for the greatest net profit in the production of butter-fat, and also in the production of churned butter. The Guernsey cows in this trial made butter at the lowest cost per pound, and returned the greatest profit in butter-production for the investment of feed. They also ranked in the production of total solids next to the heavier milking breeds. Grouping the cows in this test as a whole, the Guernsey cow, Mary Marshall, made the greatest net profit of any cow in production of butter, and viewed from the same standpoint, we find three of the five Guernseys among the best five cows in the entire fifty.

Distribution.

The even temperament of Guernsey cattle has been very conducive to the adaptability of the breed to the various climates and conditions of the world at large. They are found mainly on Guernsey island, in England, Canada and the United States. The only hindrance to their widespread introduction has been the fact that for the last few years there have not been enough animals to supply the demand. At the present time they are largely on private estates and where high-class dairy products are demanded. There are few persons, if any, at the present time breeding Guernseys from the speculative standpoint. They will be found largely in New England, through New York, New Jersey and Pennsylvania, and in Ohio, through Wisconsin and eastern Minnesota, although there are a number scattered throughout California, Virginia and the Carolinas.

Uses.

For milk, cream and butter.—The chief characteristic of the Guernsey is her economical production

of the highest natural colored milk, cream and butter. In this she has excelled and proved herself in all impartial trials. In England, and to a growing extent in this country, there is an impression that with this natural high color of her products there is a special and very desirable flavor. While the Guernsey is preëminently a cream and butter breed, it has been found within the last few years that the color and flavor of her milk, combined with a good amount which she is able to produce, has placed her a favorite in catering to the choicest trade in the sale of milk and cream. Today, in nearly all our largest towns and cities, this trade will be found supplied with the products of full-blood and grade Guernseys.

This characteristic has appealed to two classes of dairymen — the progressive ones who are producing strictly high-class dairy products for a critical trade, from which the highest returns are secured, and those who desire the best flavored and colored milk, cream and butter for use on their private estate. To the former, the fact that in impartial trials the Guernsey has shown greater returns for a dollar invested in food when cream or butter, and even high-grade milk, is produced, is sufficient to win for her a good trial. Wherever her golden-colored products are shown they are sure to win recognition. Numerous instances can be cited in which the products of herds of Guernseys are supplying such markets. A good grade Guernsey cow is eagerly sought in the higher-class dairies.

The American Guernsey Cattle Club was the first to establish an advanced register on a yearly basis. During the few years that this has been established, the records of 579 cows and young heifers have been followed. The average of these is a good index of the capability of the breed. These records show an average year's yield of 8,000 pounds of milk, 408 pounds of butter-fat, and 5.08 per cent of butter-fat. During this time the highest records made have been 17,297 pounds of milk, and 857 pounds of butter-fat. The latter is equivalent to 1,000 pounds of butter. There can be no better indication of what a breed is capable of doing, than what it will do year in and year out. A cow that will average five years in succession 12,000 pounds of 5 per cent milk, and this determined by public supervision, is most creditable. This has been done by a Guernsey.

For cheese.—The composition of Guernsey milk adapts it for the preparation of high-grade cheese, but because of the demand for the milk, cream and butter, it is not used largely for cheese-making.

For beef.—While a distinctively dairy breed, the size of the Guernsey allows her easily to be converted as a young animal, or when past her usefulness as a milker, into beef. There are few prettier sights than those seen in the meat division of the great market of St. Petersport on the island of Guernsey, and this testifies what can be done with the breed in this respect.

For crossing.—The prepotency of the Guernsey bull, or his ability to stamp the desirable characteristics of the breed on his offspring, makes him most valuable for improving the common dairy stock of any section. If he is employed intelligently, he will get grade cows yielding rich milk, and possessing good constitution and productivity.

Organizations and records.

The Royal Guernsey Agricultural and Horticultural Society directs the interests of the breed on Guernsey island. It maintains a herdbook for general registration. In 1885, the English Guernsey Cattle Society was organized. It issues a herdbook. The American Guernsey Cattle Club was organized in 1877. It has published sixteen volumes of the herd register, and there were recorded in October, 1907, 12,496 males and 23,330 females. Nearly three-fourths of the animals have been placed in the herd register since the World's Columbian Exposition in 1893. Since 1895, the register has been issued in quarterly parts, and is known as the American Guernsey Herd Register and Breeders' Journal. A department of the herd register is maintained as an advanced register. It now contains the names of over 600 animals. At the present time there are about 240 active members of the American Guernsey Cattle Club, and some 1,100 breeders of Guernseys. The headquarters of the club are at Peterboro, New Hampshire.

Literature.

Hazard, The Jersey, Alderney and Guernsey Cow, Philadelphia (1872); herd register of the American Guernsey Cattle Club. [For further references, see page 302.]

Hereford Cattle. Figs. 132, 376, 377.

By *Charles Gudgell.*

The Hereford is a breed of cattle raised for the production of beef.

Description.

The most distinctive feature of the Hereford to the ordinary observer is his color markings, or the distribution over the body of the red and white colors. The head, including jaws and throat, is white, with white under the neck, down the breast, under the belly and more or less on legs. The bush of the tail is also white, and there is a white strip on the top of the neck from about the middle thereof to the top of the shoulders. The body, sides of the neck, and usually some parts of the legs, are red. The red in different animals varies from very light or yellow-red, as it is termed, to very dark red. An animal is classed in point of color as a light red, a medium red, or a dark red. The foregoing is the popular distribution of the colors of the Hereford, yet there is sometimes a considerable variation therefrom in different animals. While as a breed of cattle they are very uniform in conformation and color markings, yet they do not have by any means the same degree of uniformity as the self-colored undomesticated animals.

The head of the Hereford is short, with broad forehead; the eyes are full and not sunken; the horns are usually rather strong and of a whitish yellow color, free from black tips, in the best types,

and come forward with a more or less drooping tendency; the neck is short and thick, merging smoothly into the shoulders, free from surplus skin in the under parts; the hide is heavy, loose and very pliable, and covered with a dense, soft coat of hair. The body of a well-fattened Hereford should be free from any paunchiness. The breast should be broad and full, but free from loose dewlap, the shoulders smoothly laid and broad on top, but not too open between the blades. The crops should be wide, the ribs well sprung and extending well backward, the loin broad and of good length, the hook-bones by no means prominent, but down within the lines of the ribs, the tail-head on a line with the level of the back, and the rump-bones wide apart and well up, so as not to present a drooping appearance. The legs should be short, straight, strong in bone and set well apart. The line of the back should be practically straight and level from top of shoulders to the tail-head. The quarters should be full and well rounded, and the outlines of the animal, when viewed from the side, should present a somewhat box-like appearance, and from the end more that of a barrel.

The Hereford has great length and thickness of loin, and all the bones of his frame are so well covered that they can scarcely be felt through the thick covering of flesh. Along his back from shoulder to rump his spine is so deeply buried in flesh that the vertebræ are not perceptible to the touch except at the small indentations, commonly called ties, near the middle of the back. These ties, usually one to three in number, are the attachments of the skin to a few of the forward lumbar vertebræ, and are common to all cattle. The indentations are caused by the up-lifting of the skin surrounding the tie by a great deposit of flesh along the spinal column. When of a pronounced character, these ties are not looked on with much favor by the breeders of fancy Herefords, as they detract somewhat from the smooth, rounded appearance of the body, although they are a very reliable indication of the great depth of flesh that covers the frame of the animal. Breeders sometimes loosen these ties in animals they are fitting for exhibition by a slight surgical operation, that is not of very difficult execution, whereby the depression in the skin disappears and leaves the back perfectly smooth and even.

The coat of hair of the Hereford is regarded by the breeders as a feature of much importance. The preference is that it should be long, soft and curly, as indicative of a certain degree of quality in the animal. Such coats are regarded as furnishing some protection against cold in winter and, in some animals, a protection against flies in summer. At the great fairs and other shows, much care is taken by the Hereford exhibitors to have the coats of their animals properly cleaned and manipulated, so as to present a curly appearance and set off the form of the animal to the best advantage.

The most valuable characteristic of the Hereford is his disposition to accumulate flesh at all ages. The Hereford is almost universally credited with being a superior rustler under range conditions. His ability to withstand rigorous conditions is due mostly to his capacity and diligence in laying up stores of flesh during the season of plenty on which he may draw in a season of want. The superior fleshing disposition of the Hereford has been demonstrated many times in the feed-lots of the corn-belt, where large numbers of the grades of all breeds are collected and fed for market under like conditions, and the Herefords are the first to be shipped to the market.

The American Hereford Cattle Breeders' Association has never adopted a scale of points for judging purposes.

History.

The Hereford breed of cattle originated in the southwestern part of England, in a district the center of which is the county of Hereford. It doubtless had its foundation in the native cattle of that district in the same way that the other English breeds of domestic cattle had their origin. The name Hereford was at first used to designate the cattle generally of that district. These cattle were historically mentioned at a very early date (1627), as possessed of remarkably easy-keeping and fattening qualities. Later the term Hereford came to be used to designate the improved and pedigreed cattle that had been developed into a race with well-established breed characteristics that were reliably transmitted. Many of the early breeders had different objects or ideals in breeding, with the result that the Hereford cattle of that day had a great diversity of color as well as of physical features.

The colors that predominated among Hereford cattle at the time of the preparation of the first volume of the herdbook of Hereford cattle (about 1845) were varying shades of red on the body with white face, and the same with mottled or spotted face, and also varying degrees of roan or gray, as it was called, on the sides of the animal, with all the other parts white. In the establishment of the improved and pedigreed Herefords, different breeders manifested a preference for animals of one or the other of these markings, and each zealously maintained the same during his breeding operations. The result of this was that, about 1845, there were several different strains of Hereford cattle that were distinguished mainly by their color markings, and were designated by the name of some prominent breeder, who had originated or was closely connected with the development of this particular strain. Subsequent breeders very wisely interbred these different strains or families, with the result that in a few years the breed became of a uniform color and markings, as of the present day.

The Hereford is among the oldest, if not the oldest established of the English breeds of domestic cattle. Some of its early improvers were contemporary, and some antecedent to the operations of Bakewell, who began his great work as a scientific breeder about 1755. As an evidence of the importance and advancement of the Hereford in production of beef at an early date, it may be cited

that the prize for the champion steer over all breeds at the first show of the Smithfield Club held at London in 1799 was won by a Hereford steer, and the same for several subsequent years. At a dispersion sale by auction of the breeding herd of one of the early improvers of the Hereford, held in

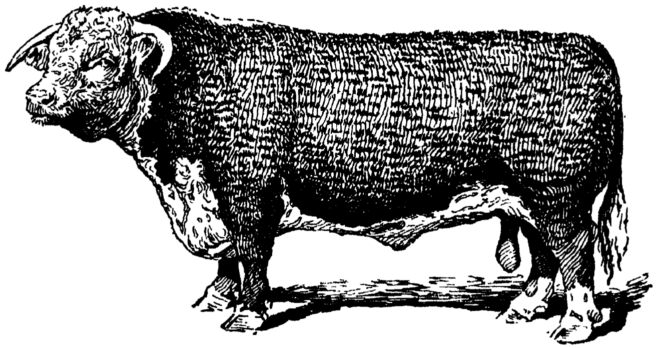

Fig. 376. Hereford bull. Dandy Rex 71689

1819, the average of the sale was about $750 per head.

In America.—Importations of a few head of Herefords were made to America in 1817, 1824, and 1840. The first two of these importations were unfortunate in that in one case the bull died, and in the other the cow died. The difficulties and risks attending the making of importations of cattle at that time were so great that no attempt was made to keep up the race, and the result was that they became merged into other stocks and disappeared. The importation of 1840 was somewhat larger and more successful in that the cattle were maintained in their purity and pedigree records were kept. The descendants of this importation have continued to the present day and are registered in the American Hereford Record.

It was not until the Centennial Exposition at Philadelphia, in 1876 that the cattle-growers of the western part of the United States were attracted to the visible merits of this breed of cattle. A very attractive herd of the descendants of later importations was on exhibition on this occasion. To nearly all of the cattle-men of the West the Hereford was an unheard-of breed, and their uniformity, color and markings, together with their beef-carrying qualities, were revelations to them. As the cattle-growing interests were at that time assuming enormous proportions in the country west of the Missouri river, these visiting cattle-men were the more easily prevailed on to give the Herefords a trial under their system of production.

In the few succeeding years all the bulls obtainable of this breed were bought and shipped to different parts of the range country from Wyoming to Texas. It was then developed that the Hereford bull, when bred to range-bred cows, transmitted to his progeny his breed characteristics to a great degree, and ranchmen proceeded at once to make arrangements to introduce Hereford bulls into their herds. The popularity of the breed steadily grew and spread throughout the cattle-growing sections, and it soon became evident that they were impressing their characters on the improved range stock. This wave of popularity has not been confined to the cattle-growers of the United States, but has overflowed the borders into Mexico and Canada and now bids fair to leave a similar impress on the beef-producing herds of those countries.

For some years the appreciation of the Herefords was based mainly on their ability to withstand hardships and produce beef on grass and under the rigorous conditions of the range. Later, when the conditions on the ranges had changed somewhat, the range-raised grade Hereford steers found their way into the feed-lots of the corn-growing states, where they gave an even better account of themselves in the matter of quick-feeding, economy of production, and quality of product when finished, than they did on the ranges. At first only steers two years old and over were admitted to the feed-lots, but later high-grade steer calves of this breed were taken directly from the range into the feed-lots. This opened up a new field in the production of high-class beef. The experiments in full-feeding high-grade calves were so satisfactory that a great demand for this class of feeding cattle has resulted. The calves are taken from their mothers on the range at weaning age in the fall and are shipped directly to the feed-lots, where they are full-fed and grazed for about twelve months. Then, as yearlings, they go to market weighing 1,000 to 1,200 pounds, where they are known as "baby beef," a product that is not produced so successfully and profitably from the grades of any other breed of cattle than the Hereford.

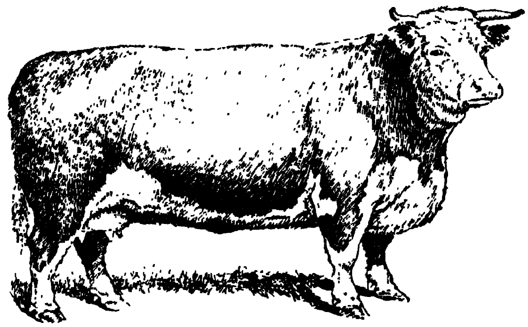

Fig. 377. Hereford cow. Lady Matchless 2d.

At the time that Hereford bulls were introduced on the ranches, herds of pure-bred Herefords in America were few in number and small in size, so that they were unable more than partially to supply this demand, with the result that Hereford bulls were high in price. This awakened a lively interest in the breed, such as had not been experienced, and a number of new herds were established. To supply the demand for bulls, importations of breeding herds were made from England in such numbers and in such rapid succession in the years

1880 to 1886, that it looked as though the registered stock in the place of their origin, which were never very large, would become exhausted. During this period several thousand head were imported and many new herds were established, mainly in the cattle-feeding states. Herefords were exhibited at all the leading fairs. A fat-stock show was inaugurated at Chicago in 1879, and a few years later another at Kansas City, Mo. Steers were secured from the supply available and exhibited with remarkable success. While the Herefords were able to secure a goodly share of the prizes in the older classes and in the champion rings at these fat-stock shows, yet it was soon observed that they were nearly always successful in the younger classes.

Owing to the shortness of the legs, and general roundness of body of the Herefords, they are frequently misjudged as to their weight, and are generally thought to be smaller in size than some of the other beef breeds of cattle. A comparison of the official weights of the prize-winners in the classes for Herefords and Shorthorns at the now American Royal Live-Stock Show at Kansas City, Missouri, showed practically no difference in the average weights of the prize-winners in the classes for bulls and cows two years old and over. But in the classes for calves and yearlings, the average weights were always decidedly in favor of the Herefords.

Although in the importations of breeding Herefords that were made in the year 1880 to 1886, all the animals imported were not high-class specimens, there were among them many of the very best cattle both individually and in breeding to be had in England. From individuals of these importations have been developed families or strains that have become very popular. On the foundation of these importations the American breeder has made a very great improvement in the conformation of the Hereford.

Distribution.

The Hereford has been introduced and used extensively in most parts of the world where attempts have been made to improve the cattle grown mainly for beef purposes. They were in use in considerable numbers in Australia and New Zealand some years before they were brought to America to any extent. Large herds of registered Herefords are now established in these countries, and a herdbook society has been organized that publishes a registry for the breed in that section. Some years ago an importation of Herefords was made from Australia to California for the foundation of a herd in that state. The Herefords have been taken to several of the South American countries, mainly to Argentina and Uruguay.

In recent years some Herefords have been taken to Cuba and Porto Rico, to some of the Central American states and to the Sandwich islands, where they are reported as doing extremely well. The breed is preëminently adapted to the range, with its vicissitudes of cold and scant vegetation. For this reason, in the United States they are found mainly west of the Mississippi, although herds are maintained in New England. It has already been said that the breed has made its way into Canada and Mexico.

Feeding.

The strong point with the Hereford in the production of beef is his ability to grow and develop on grass alone. He was developed in a great grazing district, and his first reputation was based on his capacity for converting grass into beef. While he surpasses other breeds as a grazier, he is equally prominent in the feed-lot. All cattle feeds are acceptable to him, and he responds as promptly as any to a ration of grain. In the production of high-class Herefords for breeding purposes, it is essential that they should have the best of feed and care, for such cattle cannot be produced otherwise.

Uses.

For milk.—This breed makes no claim to milk-production, and no efforts have been made in America to develop this faculty.

For beef.—Hereford cattle are primarily beef animals, and in this capacity they stand in the first rank. They are especially valuable for the production of "baby beef." In the matter of early maturity, they are unexcelled.

Organizations and records.

The first organization of the breeders of Hereford cattle in America was the Breeders' Live-Stock Association, organized in 1878, at Beecher, Ill. It undertook the publication of a monthly periodical called the Breeders' Journal, which was devoted mainly to presenting the merits of Hereford cattle. At the same time it inaugurated a herdbook — the American Hereford Record, Volume I of which appeared in 1880, and Volume II in 1882. In 1883, it disbanded, having sold its interest in this Record to the American Hereford Cattle Breeders' Association, which was organized at Chicago, Ill., in June 1881, and was incorporated under the laws of Illinois in 1883. At the second meeting of this Association, in November, 1881, the total enrollment of breeders as members numbered thirty-four. In 1883, it purchased the copyright and unsold copies of Volumes I and II of the American Hereford Record. It continued the publication of the herdbooks, and thirty volumes have been published to date. There are now over 3,200 members in the Association.

The entry numbers in the American Hereford Record at the time of its purchase by its present owners were a little over 6,000. These numbers were assigned to both male and female entries, and were very largely of ancestors of cattle owned in America. At the present time the number of entries is nearly 275,000. The rules do not require an entry to be made until the animal is nearly two years old, although the application for entrance must be filed with the office before the animal is six months old. The number of entries annually made at the present time is almost 30,000, which

fairly represents the annual increase that reach a breeding age. The office of the American Hereford Cattle Breeders' Association is in Kansas City, Mo.

The Hereford Herdbook of England appeared in 1846, of which thirty-eight volumes have been issued. The Hereford Herdbook Society of England was organized in 1878, since which time it has been responsible for the publication of the herdbook. A herdbook society has been organized and a registry published for the Hereford breeders of Australia and New Zealand. Herdbooks have also been established for the breed in Argentina and Uruguay.

Double-Standard Polled Herefords

Since the introduction into the United States of the polled breeds of cattle from Scotland, the hornless feature in cattle has found favor with some of the breeders and admirers of the Hereford. The fact that Hereford feeding steers that have been artificially made polled or dehorned are so much preferred in the feed-lots to those that are horned has led a few breeders to undertake to establish a strain of registered Herefords that are naturally polled or hornless. This has been accomplished in the case of the Shorthorn breed of cattle, and is in a fair way to be realized in the Hereford. However desirable the hornless feature may or may not be (there is a great difference of opinion among breeders on this subject), the elimination of the horns from the Hereford by a natural process has been no easy undertaking. Of the more than 240,000 registered Herefords that have been bred in this country in the past quarter of a century, a very few, possibly less than twenty head from horned sire and dam, have been naturally polled.

The great rarity of sports of this kind among the Herefords has made the establishment of a strain of registered polled Herefords a slow and difficult undertaking. However, several breeders are now devoting themselves to this work with considerable enthusiasm and some degree of success. At the present time there are about one hundred head of all ages of naturally polled Herefords that are registered in the American Hereford Record. These polled Herefords are denominated by their breeders Double-Standard Polled Herefords, to distinguish them from a class of polled cattle that are registered in the herdbook for polled Herefords exclusively, but are not eligible to record in the American Hereford Record.

The difficulties that the breeders of polled Herefords have encountered are two-fold. In the first place, the scarcity of materials to work on has necessitated very close breeding, in order to preserve the hornless feature. In the second place, those hornless sports were unfortunately not high-class either individually or in breeding, so that in strengthening the desired hornless feature by close breeding, the breeders at the same time were fixing in their cattle some undesirable features in other respects. By careful breeding and feeding, these difficulties will be overcome in time, but it will take a much longer time under the conditions that prevail to establish a strain of Herefords that will be popular because of their meritorious qualities other than the polled condition.

Two associations of the breeders of polled Herefords have been organized, one of which is called the American Polled Hereford Cattle Club, with the office of its secretary at Des Moines, Iowa. The other organization is called the National Polled Hereford Breeders' Association, and has its office in Chicago, Illinois. Both of these small organizations have begun the preparation of herdbooks for polled Herefords. Neither of them has as yet progressed to the point of publication of the first volume, and it is likely that it will be several years before that stage of development has been reached. Both of these herdbooks accept for registration the double standard variety of polled Herefords, and also other naturally polled Herefords that are not eligible to registry in the American Hereford Record.

Literature.

In England there is a History of Hereford Cattle, by Macdonald and Sinclair (1886), that is very valuable, as treating of this breed in its native home. A history of Hereford Cattle is in preparation by Alvin H. Sanders, of Chicago. [For further references, see page 302.]

Holstein-Friesian Cattle. Figs. 131, 378, 379.

By *Solomon Hoxie.*

The Holstein-Friesian breed of cattle is the American representative of the great lowland race of cattle found on the rich alluvial land in Europe, bordering the eastern shores of the North sea. It is a dairy breed, possessing valuable beefing qualities.

Description.

In color, the Holstein-Friesian is invariably black and white piebald. It is specially characterized by great constitutional vigor, flexibility, thrift and enormous production of milk of comparatively low percentage of butter-fat.

The ideal type of this breed, which has become constant in North Holland and Friesland, is designated as "milk and beef form." This form involves great breadth and length of rump; superior width of hips, with loin slightly rounded; well-sprung ribs; rounded body, with the abdomen well held up; a straight chine; shoulders slightly lower than hips and rounded at tops, from whence the neck starts out level, or nearly so, and is carried symmetrically to a finely formed throat and rather long head, bearing a broad muzzle. It also involves comparative fineness of limbs, and quarters broad at sides and rear without puffiness; a capacious udder of considerable depth, carried well forward in front and well up in rear, and a large development of mammary veins. An animal of this form will appear wedge-shaped, viewed both from front and side.

This ideal type, however, varies with respect to locality and breeding purpose. It "is identified,"

CATTLE

says Professor Hengerveld, "with their use, lodging, feeding and management." The tendency of breeding, in the United States, is now strongly in the direction of milk form. A chief merit of the breed is its adaptability to widely different environments and purposes. The type may be changed to meet the exigencies of the special situation with little sacrifice of constitutional vigor, thrift and productiveness.

The heifers mature rapidly, and, if well fed, are ready to breed at twelve to fifteen months of age. As a rule, they deliver their calves without difficulty and may be relied on to enter the dairy herd, productively, when two years old.

The following scale of points, revised and adopted by the Holstein-Friesian Association of America, June 1, 1904, shows the importance attached to the development of the parts of the animal.

Scale of Points for Holstein-Friesian Cattle

For cows	Perfect score
1. **Head.**—Decidedly feminine in appearance; fine in contour	2
2. **Forehead.**—Broad between the eyes; dishing	2
3. **Face.**—Of medium length; clean and trim, especially under the eyes, showing facial veins, the bridge of the nose straight	2
4. **Muzzle.**—Broad, with strong lips	1
5. **Ears.**—Of medium size; of fine texture; the hair plentiful and soft; the secretions oily and abundant	1
6. **Eyes.**—Large, full, mild, bright	2
7. **Horns.**—Small, tapering finely towards the tips; set moderately narrow at base; oval; inclining forward, well bent inward; of fine texture; in appearance waxy	1
8. **Neck.**—Long; fine and clean at juncture with the head; free from dewlap; evenly and smoothly joined to shoulders	4
9. **Shoulders.**—Slightly lower than hips; fine and even over tops; moderately broad and full at sides	3
10. **Chest.**—Of moderate depth and lowness; smooth and moderately full in the brisket, full in the foreflanks (or through at the heart)	6
11. **Crops.**—Moderately full	2
12. **Chine.**—Straight; strong; broadly developed, with open vertebræ	6
13. **Barrel.**—Long; of wedge shape; well rounded, with a large abdomen, trimly held up; (in judging the last item age must be considered)	7
14. **Loin and hips.**—Broad; level or nearly level between the hook-bones; level and strong laterally; spreading from chine broadly and nearly level; hook-bones fairly prominent	6
15. **Rump.**—Long, high, broad with roomy pelvis, nearly level laterally; comparatively full above the thurl; carried out straight to dropping of tail	6
16. **Thurl.**—High, broad	3
17. **Quarters.**—Deep, straight behind; twist filled with development of udder; wide and moderately full at the sides	4
18. **Flanks.**—Deep, comparatively full	2
19. **Legs.**—Comparatively short, clean and nearly straight; wide apart; firmly and squarely set under the body; feet of medium size, round, solid and deep	4

Scale of Points for Holstein-Friesian Cattle, continued.

For cows	Perfect score
20. **Tail**—Large at base, the setting well back; tapering finely to switch; the end of the bone reaching to hocks or below; the switch full	2
21. **Hair and handling**—Hair healthful in appearance, fine, soft and furry; the skin of medium thickness and loose; mellow under the hand; the secretions oily, abundant and of a rich brown or yellow color	8
22. **Mammary veins.**—Very large; very crooked (age must be taken into consideration in judging of size and crookedness); entering very large or numerous orifices; double extension, with special developments such as branches, connections, etc.	10
23. **Udder.**—Very capacious; very flexible; quarters even; nearly filling the space in the rear below the twist, extending well forward in front; broad and well held up	12
24. **Teats.** Well formed, wide apart, plumb and of convenient size	2
25. **Escutcheon.** Largest, finest	2
Perfection	100

For bulls	Perfect score
1. **Head.**—Showing full vigor; elegant in contour	2
2. **Forehead.**—Broad between the eyes; dishing	2
3. **Face.**—Of medium length; clean and trim, especially under the eyes; the bridge of the nose straight	2
4. **Muzzle.**—Broad, with strong lips	1
5. **Ears.**—Of medium size; of fine texture; the hair plentiful and soft; the secretions oily and abundant	1
6. **Eyes.**—Large, full, mild, bright	2
7. **Horns.**—Short, of medium size at base, gradually diminishing towards tips; oval, inclining forward, moderately curved inward; of fine texture; in appearance waxy	1
8. **Neck.**—Long; finely crested (if the animal is mature), fine and clean at juncture with the head; nearly free from dewlap; strongly and smoothly joined to shoulders	5
9. **Shoulders.**—Of medium height, of medium thickness, and smoothly rounded at tops; broad and full at sides; smooth over front	4
10. **Chest.**—Deep and low; well filled and smooth in the brisket; broad between the fore-arms, full in the foreflanks (or through at the heart)	7
11. **Crops.**—Comparatively full, nearly level with the shoulders	4
12. **Chine.**—Strong, straight, broadly developed, with open vertebræ	6
13. **Barrel.**—Long, well rounded, with large abdomen; strongly and trimly held up	7
14. **Loin and hips.**—Broad; level or nearly level between hook-bones; level and strong laterally; spreading from the chine broadly and nearly level; the hook-bones fairly prominent	7
15. **Rump.**—Long, broad, high, nearly level laterally; comparatively full above the thurl; carried out straight to dropping of tail	7
16. **Thurl.**—High, broad	4
17. **Quarters.**—Deep, broad, straight behind, wide and full at sides; open in the twist	5
18. **Flanks.**—Deep, full	2
19. **Legs.**—Comparatively short, clean and nearly straight; wide apart; firmly and squarely set	

SCALE OF POINTS FOR HOLSTEIN-FRIESIAN CATTLE, continued.

For bulls	Perfect score
under the body; arms wide, strong and tapering; feet of medium size, round, solid and deep	5
20. **Tail.**—Large at base, the setting well back; tapering finely to switch; the end of bone reaching to hocks or below; the switch full . .	2
21. **Hair and handling.**—Hair healthful in appearance; fine, soft and furry; skin of medium thickness and loose; mellow under the hand; the secretions oily, abundant and of a rich brown or yellow color	10
22. **Mammary veins.**—Large, full, entering large orifices; double extension, with special development, such as forks, branches, connections, etc.	10
23. **Rudimentary teats.**—Large, well placed . . .	2
24. **Escutcheon.**—Largest, finest	2
Perfection	100

This Holstein-Friesian type differs markedly from that of other pure-bred cattle known in the United States. From the Jersey it is distinguished by much greater size, much leveler top lines, fuller muscles, a more uniform color, and much greater production of milk of lighter color, and less percentage of fat; from the Guernsey, by differences of structure, as indicated for the Jersey, but to a less extent, of color and milk-production, but by less difference in size; from the Ayrshire, by differences of color and size, but by less difference in quality and quantity of milk, and by a greater difference in style and length of horns; from the Brown Swiss, by difference in color, weight of limbs, and by a nearer approach to the ideal milk form; from the Dutch Belted, by scattered markings and smaller horns. Compared with beef breeds, the Holstein-Friesian type shows less depth of chest, height and weight of shoulders, and less depth of brisket. In general outlines also, there is a marked difference, the beef type forming a parallelogram from the side view rather than a wedge form, as in the dairy type.

History.

The Holstein-Friesian cattle originated with the ancient Friesland people, a tribe which, at the time of our earliest historical knowledge of it, occupied the shores of the North sea, between the river Ems and the Rhine. The Friesians were the oldest inhabitants of Holland, and were known as herdsmen, hunters and fishermen. Their history dates as far back as three hundred years before Christ. The Batavians came two hundred years later. They were likewise herdsmen, but occupied themselves more particularly with hunting and fishing. Tacitus says of the Friesians and Batavians: "They owned cattle, not excelling in beauty, but in number." The present farmers of North Holland and Friesland, are lineal descendants of these ancient people, and the multitude of black and white cattle which they own are lineal descendants of the cattle owned by their ancestors. In North Holland at the present time there are some 80,000 head of pure-bred cattle of this breed, and in Friesland at least 125,000. They are found in other provinces of Netherlands to a limited extent.

The lowland race of which this breed is the leading representative has been the prolific mother of other breeds in Europe. From it have sprung the East Friesian and Oldenberg breeds of Germany, the Jutland breed of Denmark, the Kolmogorian breed of Russia, and the Flamande or Flemish breed of Belgium and northern France. These approach each other in color, but differ in other important characteristics. They have been produced largely by the effect of different environments, and are maintained in their purity, in the different localities, by well-established herdbooks. According to the naturalist, Low, also, before the development of English dairy breeds Friesian cattle were imported into that country, and established especially in the district of Holderness on the north side of the Humber, whence they extended northward through the plains of Yorkshire. It is asserted that from the mixture of this Friesian breed with the native cattle finally sprang the improved Shorthorn. Friesian cattle were also made the basis of the composite Rosentein breed, which was so greatly admired by Klippart, and described by him in his report to the Board of Agriculture of Ohio in 1865.

In America.—It is probable that cattle of this breed were brought to America by the early Dutch settlers and that a few were imported late in the eighteenth and early in the nineteenth centuries. The Holland Land Company is reported as having sent a few animals to Cazenovia, New York, in 1795. William Jarvis imported a bull and two cows in 1810, for his farm at Weathersfield, Vermont. Another importation into New York State was made in 1825. The first importer, however, to establish and maintain a pure-bred herd, was Winthrop W. Chenery, of Belmont, Massachusetts. He made importations in the years 1852–7–9, and 1861. Until 1871, these cattle were almost universally known in this country as Dutch, although as early as 1864 the United States Department of Agriculture had recognized them as Holstein cattle. In that year (1871), the Association of Breeders of Thoroughbred Holstein Cattle was organized with Mr. Chenery at its head. This gross error in the renaming of a well-known breed was regarded by the Dutch breeders as a great injustice to them. They protested vigorously, and finally, unable to secure justice directly, in 1873, assisted Thomas E. Whiting, of Massachusetts, to select and purchase a herd of their cattle, pledging him to establish in America a herdbook which should maintain the correct name of the breed. This herd finally came into the hands of the Unadilla Valley Breeders' Association, who, with other owners, organized in 1879, the Dutch-Friesian Cattle Breeders' Association of America. A sharp controversy ensued, which was finally brought to a close in 1885, through the union of the contending bodies in the present Holstein-Friesian Association of America.

The significant history of this breed in America

centers almost entirely about the establishment and maintenance of a system of advanced registration. The advanced registry system was originated by Solomon Hoxie, while secretary of the Dutch-Friesian Association. The necessity for it was suggested to him by the fact that many cattle of doubtful merit and unknown breeding were being entered in the Holstein herdbook. There was need of recognized intrinsic standards of merit to serve as guides in breeding and selection. Accordingly, he induced the Dutch-Friesian Association to maintain an advanced register, in which cattle should be entered only in case of special merit, determined for bulls by means of an official scale of points, and in the case of cows by an additional scale of productiveness. While there was much early opposition to the advanced register, it has abundantly demonstrated its value. Since about 1894, it has been recognized as the chief means for the advancement of the interests of the Association and of its members, and its essential principles have been adopted by other breeders' organizations both in America and Europe. It is to be regretted that descriptions and measurements in the practical operation of the system have been abandoned. It is also unfortunate that the Association, while admitting cows to the advanced registry only on the basis of the yield of butter-fat, tacitly sanctions the use of too low a factor for the conversion of butter-fat into butter records. The factor 80 per cent, generally used, cannot be too severely condemned, since repeated demonstrations show that good marketable butter requires the presence in the milk of at least 85.7 per cent of its weight of butter-fat.

Distribution.

This race of cattle is widely distributed on the continent of Europe, prevailing especially in northern France and along the shores of the English channel and the North sea, as far as Denmark.. It is the leading dairy breed in Russia, occupying the shores of the River Dwina and the White sea nearly to the Arctic circle. It is firmly established in nearly every province of Germany, in Italy, Sweden and Denmark. It is also bred in South Africa, and is rapidly being introduced into Japan. Introduced into the United States less than fifty years ago, it has spread to every important dairy section of this country and to Canada, and more recently to Mexico. It is specially adapted to rich, level grass-lands and to densely populated, highly civilized countries in which milk and its every product, and veal and beef of superior quality are in demand.

Feeding and care.

The extraordinary vigor of cattle of this breed permits very wide latitude in caring for and feeding them. In some sections of Holland "they are found on lands covered with water plants and grass of small nutritive value." In northern Russia they are successfully kept in the frigid climate near the Arctic circle. The only hard-and-fast rule for feeding is: "Feed abundantly well-balanced rations." The breeders in Holland and Friesland confine their cattle in their stables constantly from the middle of November through the winter till the middle of May, apparently without injury to them, at much less expense of food and with greater production of milk than results from the practice of daily exposure to the outside atmosphere, as in America. Their method requires, however, much greater air space per animal, and hence that they be confined in much larger buildings.

Fig. 378. Young Holstein-Friesian bull.

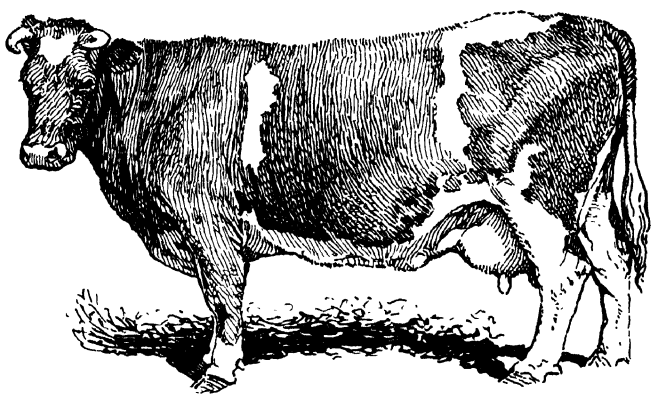

Fig. 379. Holstein-Friesian cow. Belle Sarcastic No. 1108 Adv. Reg

Uses.

For milk.— At two to three years old, the young cows produce about half the quantity of milk of mature animals of the breed, if well supplied with suitable food, or 5,000 to 8,000 pounds of milk in ten months,— the usual annual period of milking dairy cows. They will also continue their growth and increase in productiveness until four and a half or five years old, at which age they will reach, if in good milking condition, an average weight of 1,200 pounds. From this time forward, average cows of the breed will produce, when in full flow, 40 to 70 pounds of milk daily, or 8,000 to 12,000 pounds annually, until twelve to fourteen years of age, the milk ranging in quality from 11 per cent to 13.5 per cent total solids, of which 2.5 per cent to 4.5 per cent will be butter-fat. The average

yield will probably contain 12 per cent total solids and 3.3 per cent butter-fat.

Great numbers of the cows of this breed have far exceeded this range of productiveness. For example, of 350 cows that were entered in the first volume of the Holstein-Friesian Advanced Register, published in 1886, 67 produced over 12,000 pounds of milk each in a single lactation period of ten months, and 16 exceeded 15,000 pounds each. In the first four volumes of this register, 40 records are reported which averaged 18,026$\frac{1}{10}$ pounds in a lactation period of one year. Some individual records have enormously exceeded this average: Clothilde, No. 155, produced in one year, within a single lactation period, 26,921$\frac{1}{8}$ pounds; Princess of Wayne, No. 2, calving in her eleventh year, produced 29,008$\frac{11}{16}$ pounds in a similar period; Pietertje 2d., No. 497, produced, under like circumstances, 30,318$\frac{1}{2}$ pounds, and Belle Sarcastic, No. 1108 (Fig. 379), designated as the model cow of the breed by a committee appointed by the Holstein-Friesian Association to draft a scale of points, produced, in the hands of the Michigan Agricultural Experiment Station, 21,975$\frac{8}{10}$ pounds in one year, and in her full lactation period of fifteen months and one week, 27,289$\frac{1}{10}$ pounds. The highest milk production of Pietertje 2d. for a single day was 112$\frac{7}{10}$ pounds, and the highest of Princess of Wayne while making her great record was 113$\frac{1}{8}$ pounds. DeKol Creamelle recently produced in official test 119 pounds in one day, 26,280.2 pounds in one year. Colantha 4th's Johanna (Fig. 332) produced 651.7 pounds of milk, 28.176 pounds of butter-fat in seven days; 2,872.6 pounds of milk, 110.833 pounds of butter-fat in thirty days; 5,326.7 pounds of milk, 208.398 pounds of butter-fat in sixty days; 27,432.5 pounds of milk, 998.256 pounds of butter-fat in one year. Thus, Colantha 4th's Johanna holds the world's official record for the production of butter-fat for seven days, thirty days, sixty days and 365 days. These records illustrate the highest attainments of the breed thus far in the matter of milk- and butter-fat-production. For such production, the cow, of course, must receive special care and food, and must be milked three or four times a day.

The milk of this breed has several peculiar and notable characteristics. It is not highly colored. "The absence of granules, as a predominant feature, makes the skimmed milk especially appear blue." The fat globules are comparatively small and uniform in size. The cream, therefore, rises slowly, but it is dense in consequence of the compactness of the globules. The milk is richer than the color or thickness of the cream would indicate. After the cream rises to the surface it is easily re-incorporated in the milk by stirring or shaking. This renders the milk more than ordinarily valuable for direct consumption purposes, especially for city supply, since it insures to all consumers a comparatively uniform quality. Moreover, both the milk and the cream approach the structure of the corresponding human products more closely than those of any other breed which has been tested in this respect. This leads to the inference that the milk of this breed is superior to that of any other for the feeding of young children. Recent experiments made at the Storrs' Agricultural Experiment Station in Connecticut tend to substantiate this inference. Furthermore, the milk of these cattle is said to possess a quality which has recently been called "vitality," a quality very strongly associated with the vitality of the animal producing it. Thus, the high constitutional vigor of Holstein-Friesian cattle is another strong point in their favor as milk-producers.

For butter.— Butter-fat records of the breed have been no less remarkable. (See above.) In 1894, state agricultural experiment stations began the official supervision of the testing of Holstein-Friesian cows at the homes of the owners. Thousands of such tests for a period of seven consecutive days have now been made. These tests are annually classified according to the age of the cows at date of calving. A summary of such records for a single year will serve to show the butter-making possibilities of the élite of the breed. In the official year 1901-2, 191 records, of cows five years old and over, averaged 431$\frac{7}{10}$ pounds of milk, containing an average of 3.42 per cent of butter-fat, making a total of 14.684 pounds of butter-fat per cow; 48 records, of cows four and one-half years old and under five, averaged 401$\frac{2}{10}$ pounds milk, 3.52 per cent butter-fat, total fat 14.121 pounds; 47 records, of cows four years and under four and one-half, averaged 392$\frac{4}{10}$ pounds milk, 3.28 per cent butter-fat, total fat 12.858 pounds; 57 records, of cows three and one-half years and under four, averaged 373$\frac{8}{10}$ pounds milk, 3.44 per cent butter-fat, total fat 12.833 pounds; 60 records, of cows three years old and under three and one-half, averaged 360$\frac{1}{10}$ pounds milk, 3.42 per cent butter-fat, total fat 12.305 pounds; 65 records, of cows two and one-half years old and under three, averaged 333$\frac{1}{10}$ pounds milk, 3.32 per cent butter-fat, total butter-fat 11.001 pounds; 165 records, of cows under two and one-half years old at date of calving, averaged 279$\frac{7}{10}$ pounds milk, 3.55 per cent butter-fat, total butter-fat 9.369 pounds. One hundred and thirty cows of the breed have official records greater than 20 pounds of butter-fat in seven days, and sixty cows of the breed have official records greater than 80 pounds of butter-fat in thirty days. Such records are usually made at ten to fifty days after parturition. A lapse of at least five days is required. There can be no doubt as to the correctness of these records. In many cases, especially when the yield was exceptionally large, the cows were re-tested for periods ranging from twenty-four to forty-eight hours by representatives of the experiment stations, who kept constant watch in order that no milk or cream should be introduced into the udders surreptitiously.

It is not maintained, of course, that the average pure-bred Holstein-Friesian cow or heifer could produce equal records. Probably the best one-third of all those owned in this country could do so if sufficiently well fed, skilfully cared for and milked three times a day. It is probable that in butter- as well as in milk-production, the average cow of this

breed, would excel the average cow of any other known breed.

Butter made from the milk of these cows is comparatively mild in flavor and, if not artificially colored, is of a pale straw-color in summer, when the cows are fed on grass, and of a creamy white in winter when they are fed on hay. In keeping quality it ranks very high. In 1875, Mr. E. Lewis Sturtevant published an account of a comparative test of butters of different breeds, which indicated the superiority of the Holstein-Friesian product in this connection. He took seven samples of Jersey butters, four of Ayrshire, one of Guernsey and one of Dutch or Holstein-Friesian, and placed them in a cupboard adjoining a steam heater. The Guernsey sample was probably not so well made as the others. "It moulded in spots in about a month. . . . In seven weeks the Jersey butters were all rancid. . . . The Ayrshire butters were not rancid, but had lost flavor and were poor. . . . The Dutch butter was well preserved, being neither rancid or flavorless." The butter of Friesland has long been recognized as a standard product in the markets of Europe, and the butter of cows of this breed is steadily gaining favor in our own markets.

For cheese.—The milk of Holstein-Friesian cattle makes a very high grade of cheese, and it has been much used for this purpose both in Holland and in America. The milk is rich in solids other than fat.

For beef.—This breed combines with its great milk- and butter-producing capacity, good beefing qualities. For this reason it has been called a dual-purpose breed. Its calves are very large and vigorous at birth, grow rapidly and are exceptionally free from disease,—especially from that which is known as white scours. When vealed at the end of four or five weeks they dress 90 to 120 pounds. The veal is of superior color, sweetness and tenderness. The cows quickly take on flesh when dried off and add 125 to 200 pounds to their milking weight. They dress 52 per cent to 55 per cent of their live weight. While fattening, the cattle of this breed, like those of beef breeds, deposit fat largely in the interstices of the muscles, and sparingly on the intestines and around the kidneys. The meat is light-colored and marbled in appearance. It is preferred by some to the fattened product of the beef breeds.

For breeding.—In breeding, bulls should be selected that are of superior constitutional vigor and size. When fully developed they should have the outlines of a beef animal with the exception of the brisket. In all cases, the male in breeding should be the offspring of larger-sized stock than the female if possible, although the difference should not be extreme. For crossing on grade cows to increase milk-production the pure-bred bulls of this breed give very satisfactory results.

Organizations and records.

Organizations for the promotion of the interests of this breed were closely associated with the history of the breed in America (which see, page 357). It is a singular fact that while the thoughts and energies of so many generations were devoted to breeding and improving these cattle, the first public herdbook of the breed was published in 1872 by an American, Winthrop W. Chenery, of Belmont, Massachusetts, by authority of the Association of Breeders of Thoroughbred Holstein Cattle. It was known as the Holstein Herdbook. Three years later a herdbook was issued in the Netherlands, by the Netherland Herdbook Association. It was a protest against naming Holland cattle from a German province that had no valid claim to the origin of the breed. In 1879, the Dutch-Friesian Cattle Breeders' Association was formed in America. In the same year the Friesian Herdbook Association was organized in the province of Friesland. A few years later the North Holland Herdbook Association was organized and a branch was established in America. The present Holstein-Friesian Association of America was formed in 1885 by the union of the Holstein and the Dutch-Friesian Associations. It limited importations to a great extent, and in consequence of this the Netherland and North Holland Associations became nearly moribund. Recently, the former has adopted a system similar to the American system of advanced registration, and probably may become an institution of great value to breeders in all the provinces of Holland, with the exception of Friesland, where the early association was of a similar character. The Western Holstein-Friesian Association was organized in 1892, and published its first and only herdbook in 1895, containing pedigrees of 2,100 cattle. It was united with the Holstein-Friesian Association of America in 1898, and its pedigree records became a part of the herdbook of the older association. The Holstein-Friesian Association of Canada was founded in 1891.

The Holstein-Friesian Association of America was incorporated for the purpose of importing, breeding, improving and otherwise handling pure-bred Holstein-Friesian cattle, and for gathering and publishing information in regard to them. It maintains a herdbook and advanced register of cattle. The entries to its herdbook had reached, at the late annual meeting (1907), 46,626 males, and 94,829 females. The policy of this association has been to maintain the purity of the breed in America, to improve the type by selection of the most superior animals for separate or advanced registration, and to demonstrate the merits of the breed through the making of great milk and butter records. It has maintained a consistent advocacy of tests at the homes of owners under the strictest supervision of agricultural experiment stations. In this respect it took the initiative, and has compelled other breeders' associations to follow.

Literature.

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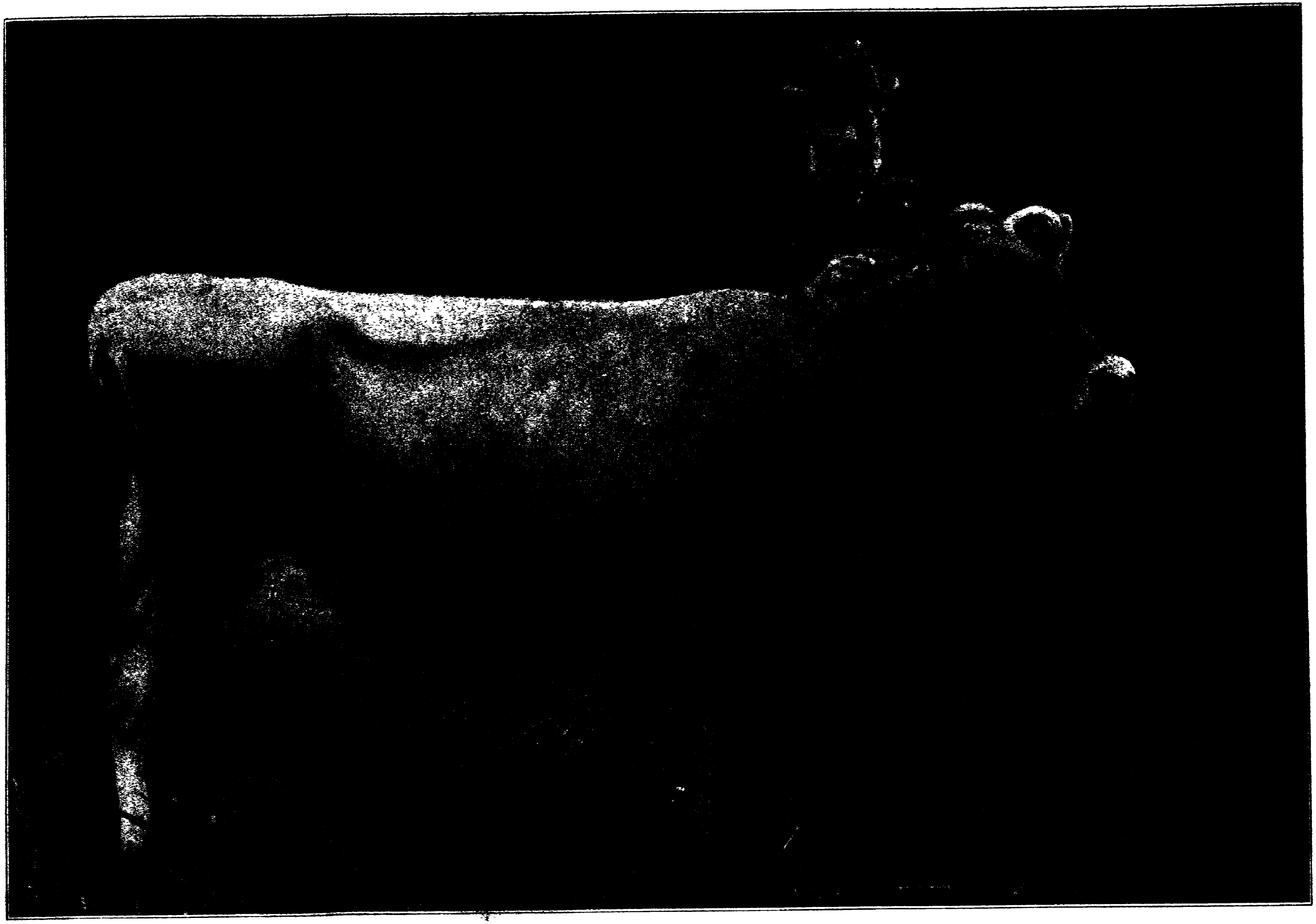

Plate XI. Jersey cow in full milk

Reports of New York State Dairymen's Association for 1878–1880; Holstein-Friesian Cattle, S. Hoxie, Holstein-Friesian Association, third edition, 1904; Advanced Registration, S. Hoxie, in Proceedings of the American Association of Live-stock Herdbook Secretaries, 1904, C. F. Mills, Editor; The North Holland or Friesian Breed, Utica, Curtis and Childs (1884), S. Hoxie, Editor; Records of Dairy Cows in the United States, C. B. Lane, Government Printing Office, Washington, D. C. (1905); History of the Holstein-Friesian Breed, Brattleboro Vermont (1897), F. L. Houghton; Cattle and Dairy Farming, United States Consular Reports, 1887; Holstein Cattle, Dudley Miller; Die Rindviehzucht im In und Auslande, J. Hansen and A. Hermes, Leipzig, Carl Schmidt & Co., 2 volumes (1905); Friesch Rundvee Stamboek, 32 volumes, 1880–1906; The Holstein-Friesian Yearbook, 1901–1907, 7 volumes, F. L. Houghton; Western Holstein-Friesian Herdbook, 1 volume, 1895, Western Holstein-Friesian Association; The Holstein-Friesian Register, Brattleboro, Vermont, F. L. Houghton; The Holstein-Friesian World, C. G. Brown, Ithaca, New York. [See also page 302.]

Jersey Cattle. Figs. 36, 37, 334, 380, 381.

By *M. A. Scovell.*

The Jersey is one of the leading dairy breeds of cattle. The island of Jersey, eleven miles long and less than six miles wide, lying in the English Channel some thirty miles from the southern extremity of England and about thirteen miles from the coast of France, is its native home.

In American and English writings there has been some confusion in the use of the term Alderney, as applied to cattle from the Channel islands. In 1844, Colonel Le Couteur wrote an article on the "Jersey misnamed Alderney cow." This article was published in the Journal of the Royal Agricultural Society of England, Vol. 5, page 43, and was afterwards copied into the Transactions of the New York State Agricultural Society in 1850, and into Volume I of the Herd Register of the American Jersey Cattle Club. It forms the basis of our knowledge of the early history of Channel island cattle. When Channel island cattle were first exported to Great Britain, they were collectively called Alderneys, because vessels plying between the Channel islands and Great Britain cleared from the port of Alderney. The cattle were actually very largely from the island of Jersey, since that is the largest island and contains the most cattle. The local government of the Channel islands is administered through two municipalities, the one, the states of Jersey, comprising the island of Jersey alone; the other, the states of Guernsey, comprising Guernsey and the other inhabited islands, of which Alderney is one. For more than a century there has been no intercommunication of cattle from outside the islands or between the two municipalities themselves. This has been one of the agencies in the establishment of the two breeds, Jersey and Guernsey, which are now and have been for many years sufficiently distinct so as to be readily recognized. Alderney is in no sense an agricultural island, and the few cattle on the island are kept merely as family cows by the inhabitants. They come, of course, from Guernsey, and are of that breed. There has never been a distinct breed known as Alderneys, and the name "Alderney" has been more commonly applied to Jersey than to Guernsey cattle.

Description.

The ideal Jersey of today has a small head, short, broad, lean and dish-faced. The muzzle, including the under lip, is black or dark in color, surrounded by a light or mealy strip of light skin and hair. The eyes are prominent, large, bright and wide apart. The horns are crumpled or incurving, small, waxy and often black-tipped. The ears are small, delicate and yellow-colored within. The neck is fine, clean and small. The legs are short, fine boned and small. The body is well hooped or rounded, large and deep. The tail is fine boned, long, with a full brush. The skin is mellow, loose, yellow, with short, fine, silky hair. The udder is large in size, extending well up behind and well forward, not pendant. The teats are medium sized, placed far apart on the udder, without having the udder cut up between them. The milk veins are generally highly developed, tortuous, knotty, and often spreading in several branches. The back should be straight from shoulder to the setting-on of the tail. So far as beauty is concerned, the sloping rump is very objectionable. The general appearance should be attractive and sprightly. The head should be erect when walking and the movements should be light, quick and graceful. When in full flow of milk, the Jersey should carry little flesh, but have muscular development enough for healthy activity and full digestive forces. The following scale of points, adopted by the American Jersey Cattle Club, shows the relative values attributed to the various parts.

SCALE OF POINTS FOR JERSEY CATTLE

For cows	Perfect score
1. **Head** (7)	
Medium size, lean; face dished; broad between eyes and narrow between horns	4
Eyes full and placid; horns small to medium, incurving: muzzle broad, with muscular lips; strong under-jaw	3
2. **Neck.**—Thin, rather long, with clean throat; thin at withers	5
3. **Body** (33)	
Lung capacity, as indicated by depth and breadth through body, just back of fore-legs	5
Wedge shape, with deep, large paunch, legs proportionate to size and of fine quality	10
Back straight to hip-bones	2
Rump long to tail-setting and level from hip-bones to rump-bones	8
Hip-bones high and wide apart; loins broad, strong	5
Thighs flat and well cut out	3
4. **Tail.**—Thin, long, with good switch, not coarse at setting-on	2
5. **Udder** (28)	
Large size and not fleshy	6
Broad, level or spherical, not deeply cut between teats	4

SCALE OF POINTS FOR JERSEY CATTLE, continued

For cows	Perfect score
Fore-udder full and well rounded, running well forward of front teats	10
Rear-udder well rounded, and well out and up behind	8
6. **Teats.**—Of good and uniform length and size, regularly and squarely placed	8
7. **Milk veins.**—Large, tortuous and elastic	4
8. **Size.**—Mature cows, 800 to 1,000 pounds	3
9. **General appearance.**—A symmetrical balancing of all the parts, and a proportion of parts to each other, depending on size of animal, with the general appearance of a high-class animal, with capacity for food and productiveness at pail	10
Perfection	100

For bulls	Perfect score
1. **Head** (10)	
Broad, medium length; face dished; narrow between horns; horns medium in size and incurving	5
Muzzle broad, nostrils open, eyes full and bold; entire expression one of vigor, resolution and masculinity	5
2. **Neck.**—Medium length, with full crest at maturity; clean at throat	10
3. **Body** (54)	
Lung capacity, as indicated by depth and breadth through body, just back of fore shoulders; shoulders full and strong	15
Barrel long, of good depth and breadth, with strong, well-sprung ribs	15
Back straight to hip-bones	2
Rump of good length and proportion to size of body, and level from hip-bone to rump-bone	7
Loins broad and strong; hips rounded, and of medium width compared with female	7
Thighs rather flat, well cut up behind, high arched flank	3
Legs proportionate to size and of fine quality, well apart, and not to weave or cross in walking	5
4. **Rudimentary teats.**—Well placed	2
5. **Tail.**—Thin, long, with good switch, not coarse at setting-on	4
6. **Size.**—Mature bulls, 1,200 to 1,500 pounds	5
7. **General appearance.**—Thoroughly masculine in character, with a harmonious blending of the parts to each other; thoroughly robust, and such an animal as in a herd of wild cattle would likely become master of the herd by the law of natural selection and survival of the fittest	15
Perfection	100

History.

The origin of the Jersey breed is conjectural, but it is probably the same as the original breed of Normandy. The earliest writers on the cattle of this Island assert that they were superior to those of Normandy and Brittany. Rev. Philip Falle wrote, in 1734, "The cattle on this Island are superior to the French." Thomas Quayle, in 1812, asserted an advantage over any other breed in the quantity and quality of cream produced from the consumption of a given quantity of fodder. Garrard, in the first part of the last century, gave the milk yield as three to four gallons per day, and the butter yield as 220 to 230 pounds per cow per year. According to Inglis, the general average produced at that time was ten quarts of milk per day and seven pounds of butter per week.

No distinct characteristics as to form and color were given by the earliest writers, except that Colonel Le Couteur mentions the fact that the Jersey farmer was content to possess an ugly, ill-formed animal with flat sides, cat-hammed, narrow and high hips, with a hollow back, yet ever possessing a lively eye, round barrel, deep chest, short, fine, deer-like limbs and a fine tail. (Fig. 36.) Nor do any of the writers give the reason why the Jersey was superior to other breeds, until the article by Colonel Le Couteur appeared in the "Journal of the Royal Agricultural Society of England," in 1845. In this article Colonel Le Couteur says: "The Jersey cow was excellent as she has ever been, which has been attributed to the circumstance of a few farmers having constantly attended to raising stock from cows of the best milking qualities, which attention, prosecuted for a long number of years in a small country like ours, where such superior qualities would soon be known, led to the excellence of milk- and butter-yielding qualities in the race. This never could have been secured so generally in Normandy, from whence our breed probably originated, or in any other extended country." We may assume, then, that the breed owes its peculiar qualities to an evolution of persistent breeding to perpetuate and accentuate distinctive qualities, and to the exclusion of all other cattle from the Island. The method of tethering, which has always prevailed on the Island, may have had its influence.

An organized attempt was made to give a fixed beauty of form to the Jersey about 1835, when, says Colonel Le Couteur, "A few gentlemen selected two beautiful cows with the best qualities as models. One was held to be perfect in her barrel and fore-quarters, the other equally so in her hind-quarters. From these two, a scale of points was laid down to be the rule for governing the judges at the cattle shows of the Jersey Agricultural Society."

At an early period, steps were taken to keep the breed pure by preventing outside cattle coming into the Island, and in 1763 an act was passed which has since been rigidly enforced, and supplemented by the further acts of 1789, 1826, 1864 and 1878, prohibiting the landing of cattle on the Island except for the purpose of slaughter. Even before the enactment of laws, the purity of the cattle was maintained by the persistence with which the Jerseyman clung to his own breed. Every effort to introduce other cattle, even from England, has been invariably rendered futile by the inhabitants.

The Royal Jersey Agricultural and Horticultural Society, organized in 1833, has been one of the chief means of improving the general character of the breed on the Island, and of developing its valuable dairy qualities. In 1836, the Society recommended that one superior bull be kept in each parish, and that encouragement be given to keep first-rate heifers in the Island, as the high prices

offered were strong temptations to export them. In 1838, it enacted at least two new rules. One was to the effect that any person withholding the services of a prize bull from the public should forfeit the premium; the other was that all heifers having premiums adjudged to them should be kept

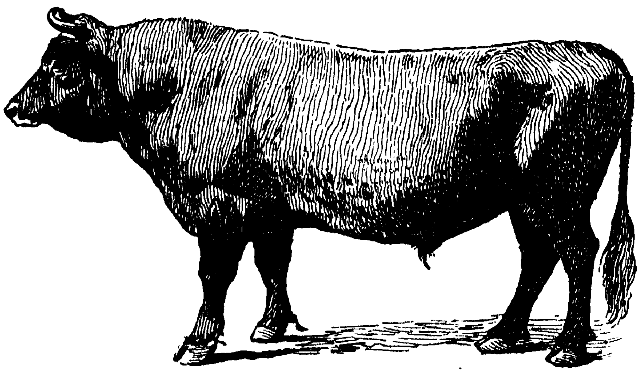

Fig. 380. Imported Jersey bull. Guenon's Lad 54422.

on the Island until they shall have dropped their first calf. If previously sold for exportation, they shall forfeit the premium.

In 1853, the Society began to recognize the fact that it was unwise to ship out of the Island the best cattle, and urged the breeders against selling their best stock to be taken from the Island, In 1862, the Society reports, "To a very considerable extent, the business of the society is limited to the improvement of our insular race of cattle, which in itself is of the highest importance. We, therefore, wish to impress an observation on those who study the improvement of their stock—beauty of symmetry alone can not ever be the acme of perfection. The latter can be obtained only when goodness and beauty are equally combined." "It is an established fact that the renown which the Jersey cow enjoys is attributable to the peculiar richness of its milk, as well as to its docility of temper and neatness of form. Now, as this richness is not so marked in some specimens as it is in others, it becomes advisable to make such selections in breeding as will ensure further amelioration in this most essential and highly important point."

Up to 1865, there appears to have been little attention paid to the quantity of milk which the Jersey gave. The quality of milk and the quantity of butter and beauty of form seem to have been the only points which the breeders had considered, up to that time. But, in that year, a committee of the Agricultural Society of Jersey urged that the Jersey breeder should pay greater attention to the milk-producing qualities of the cow, and that every cow with the least tendency to deficiency in quantity of milk should be weeded out, and suggested that the judges especially consider this in awarding prizes. It will be seen, therefore, that the Jersey has been bred for quantity of milk for only about forty years. It was in the seventies that it became the fashion, both in England and America, to select solid-colored Jerseys with black points, and for some time this color craze had a detrimental influence on the breed. But it appears that the Agricultural Society of Jersey, ever watchful of the future interests of the breed, condemned this color craze, and, in 1873, it reports, "Let henceforth such fanciful ideas as black tails and black tongues be estimated at their proper value, but let the large and rich yield of milk be ever the breeder's ambition to procure."

The Jersey herdbook was started in 1866, and it has undoubtedly had a marked influence on the improvement of the cattle in the Island. In America or in England, an animal may be registered as soon as born, if its sire and dam are registered, or are capable of being registered. On the Island, however, inspection is made a conditional precedent to registering. The following are necessary conditions to registration:

(1) Every animal must be inspected by competent judges, and, if it is considered fit, it obtains a qualification, namely, *commended* or *highly commended*.

(2) Every bull submitted for qualification must be accompanied by his dam, in order that the merits of the latter may be taken into consideration in awarding a commendation to the former.

(3) No heifer, although she may be descended from registered parents, can be entered in the herdbook until she has had a calf, and if at the time of her examination she is a poor milker, she receives no commendation.

It will readily be seen, therefore, that by the

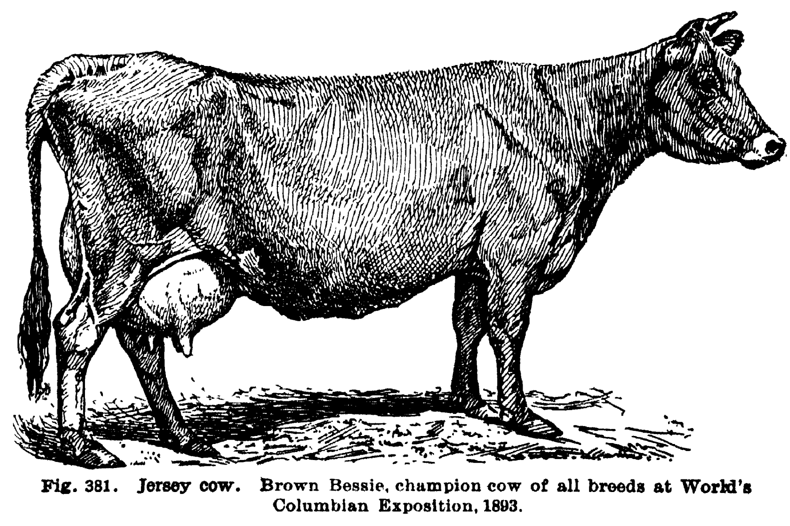

Fig. 381. Jersey cow. Brown Bessie, champion cow of all breeds at World's Columbian Exposition, 1893.

method of registration on the island of Jersey, not only the pedigree can be traced but it can be ascertained whether the dams and sires for generations back have been commended or highly commended by the commissioned judges. These commendations are shown in pedigree by the letter *C.* if commended, and by the letters *H. C.* if highly commended.

Jersey cattle were imported into England as early as 1835, and in large numbers in the forties. Professor L. W. Low, in 1845, says, "The cows are imported into England in considerable numbers, and are esteemed beyond those of any other race for the richness of their milk and the deep yellow color of their butter."

In America.—Importation into America began in 1850. In that year twelve animals were imported under the auspices of a club of farmers organized for the purpose. Only prize winners were purchased. The bull "Splendens" was in this importation, and he proved to be a very valuable animal. Other importations followed in the fifties, mostly to Connecticut, Massachusetts, New Jersey and New York, and from 1860 to 1890, importations were numerous and to nearly every part of the United States. More than two thousand head a year were imported year after year. Again, from about 1900 to the present time, many importations have been made. In fact, so numerously have Jersey cattle been imported and so rapidly have they increased in America, that they outnumber the Jerseys on the Island or any other breed of dairy cattle in this country, and they have been so largely used for grading, that the Jersey characteristics are seen everywhere dairy cows are kept.

Distribution.

The Jersey is very widely distributed, due to its wide adaptation to conditions. As has been said, it is scattered through the United States and Canada. England, France, New Zealand, Australia and many other countries can boast of large herds.

Feeding and care.

Jerseys have a capacity of assimilating large quantities of food and may be forced to advantage when in full flow of milk, as all extra food, in such case, is converted into milk. When the milk-flow begins to slacken, the food should be reduced, especially the concentrates. The Jerseys are large eaters of roughage and succulent feeds, as roots.

A good average daily ration for a Jersey that is giving forty pounds of milk a day is as follows:

	Roughage	Concentrates
Alfalfa, or clover hay . . .	20 lbs.	
Corn silage	12 "	
Wheat bran		3 lbs.
Corn meal		5 "
Ground oats		1 "
Oil meal		2 "
Gluten feed		5 "
Cottonseed meal		½ "
Total	32 lbs.	16½ lbs.

On the Island the method of caring for the cows has been the same for nearly two hundred years. In the summer they are tethered in meadows and pastures, and in the winter are warmly housed at night. The same care should be taken in the management of Jerseys in this country. They should have plenty of pasture to run on in the summer, and they should not be confined in the winter in day-time except in very cold and inclement weather. They should be treated kindly, as they have ever been on the Island. Nervous cows should be excluded from the herd, as well as those giving small quantities of milk, and those not persistent in their milk.

At one time the Jersey was supposed to be delicate, but the American breed of cows at this time seems to be constitutionally as strong as any other dairy breed, and not more subject to disease than other cattle, with possibly the exception of milk fever. But since the oxygen treatment for this disease has been used, this heretofore dreaded affliction need no longer be considered a dangerous disease.

Uses.

For milk and butter.—For many years the Jersey was bred almost exclusively for its butter-producing qualities. Many private and official butter tests have been published, giving phenomenal yields of butter. As the result of these tests, so-called families of Jerseys have sprung up, as the St. Lambert, the Signal, the Combination, the Victor, the Tormentor. But a careful review of authenticated tests, and especially the results of the official tests at the World's Columbian and at the Louisiana Purchase Expositions, show that the excellence is inherent in the breed generally, and is not confined to any particular line or lines of breeding. Of late years, much attention has been paid in the breeding of Jerseys for milk-production as well as for butter, and for beauty of form, with excellent results. Jerseys giving four to five gallons of milk per day are not rare in most herds, and such cows are noted for persistence in milking. Records are given of individual cows giving 10,000, 12,000, and even more pounds of milk in a year.

Very interesting are the results from the dairy test at the World's Columbian Exposition at Chicago in 1893, and the cow-demonstration tests at the Louisiana Purchase Exposition at St. Louis, in 1904. In both instances the cows were selected and cared for by the American Jersey Cattle Club, and it may be assumed, therefore, that the best cows in the breed available at that time were selected in each case. The test was conducted in each instance by a committee of the Association of American Agricultural Colleges and Experiment Stations. The results show that the Jersey cows can assimilate a large quantity of food, give four to five gallons of rich milk per day, and that they are persistent milkers; and if conclusions can be drawn from comparison of the two tests, each with the same number of cows, selected in the same manner, and under like conditions, it is that in eleven years the Jerseys have increased largely in flow of milk, and in the production of butter.

The records of the Jerseys in the ninety-day test

at the World's Columbian Exposition at Chicago, June–August 29, 1893, give the following summary of results for the twenty-five cows entered :

	Total lbs. milk	Average per cent fat	Total lbs. butter
Grand total	73,488.8	4.784+	3,516.1
Average per cow . . .	2,939.6	4.784+	140.6
Daily average per cow .	32.6	. .	1.56

Most of the cows had been in milk one to three months, and one at least five months prior to the beginning of the test.

The records of the Jerseys in the 120-day cow-demonstration test at the Louisiana Purchase Exposition at St. Louis, June 16–October 13, 1904, give the following summary of results for the twenty-five cows entered :

	Total lbs. milk	Per cent of fat	Lbs. of fat	Lbs. of butter
Grand total . . .	124,524.2	4.666+	5,810.7	6,841.6
Total average per cow	4,981.0	4.666+	232.4	273.7
Daily average per cow	41.5	. .	1.9	2.3

The cows averaged sixty-nine days in lactation at the time the demonstration began, so in reality at the close of the test, the cows, on an average, had been in milk nearly six months. The Jerseys not only gave over forty pounds of milk per day, but the milk was the richest of any in butter-fat, averaging 4.7 per cent, or an average of more than two pounds of butter per day for each cow, making a total of 274 pounds in 120 days. In the two months in which they were milked prior to the beginning of the test, they should have produced about the same amount of butter in proportion to the time as they had during the test, which would give an average for each cow for six months of 410½ pounds of butter. When it is remembered that the average dairy cow gives less than 250 pounds of butter per year, these results seem all the more remarkable. These results were obtained without feeding the cows to their fullest capacity and without withdrawing a single cow because of sickness. They were fed on a profitable basis, each cow earning over cost of feed nearly $40, or a daily profit of 43 cents.

It is interesting to compare results during the first and last part of the test for the purpose of showing the persistency of production and endurance. During the first ten days of the test, the Jerseys gave 10,942 pounds of milk, or an average per cow per day of 43.8 pounds ; average per cent of fat in the milk, 4.25 ; total pounds of fat, 466, or an average per cow per day of 1.86 pounds. During the last ten days they gave 9,382 pounds of milk, an average of 37.5 pounds per cow ; average per cent of fat in the milk, 5.13 ; total amount of fat 481.1 pounds, or an average per cow per day of 1.92 pounds. While the cows decreased in flow of milk, they increased both in percentage and amount of fat, and a general improvement in the productive capacity of the Jerseys is indicated by a comparison of the two tests.

For cheese.—The high butter-fat content of Jersey milk adapts it especially to the production of high-class cheese. At the World's Columbian Exposition it was given first place over the Guernsey and the Shorthorn in a cheese-making test. The demand for Jersey milk for the retail trade and for butter-making allows but little of it to be made into cheese.

For beef.—The Jersey is not pretended to be a beef-producer. The meat is of good quality but is off in color. The Jersey dresses out too small a percentage of marketable meat, compared with the beef breeds, to adapt it to the butcher's block.

For grading.—The Jerseys have been much used for grading on native cows to increase milk- and butter-production. Carefully selected bulls may be used for this purpose with very satisfactory results.

Organizations and records.

The two organizations which have done so much for the development of the Jersey are the Royal Jersey Agricultural and Horticultural Society, organized in 1833, and the American Jersey Cattle Club, organized in 1868, with offices at No. 8 West Seventeenth street, New York. In 1866, the first herdbook of the Island Society appeared. Eighteen volumes have been published to date. The Association of Breeders of Thoroughbred Neat Stock, the first organization in America to care for the breed, published six volumes of The American Jersey Herdbook, the last volume being issued in 1878.

The American Jersey Cattle Club has done much to develop and keep the blood of the Jersey pure in this country. The Club registers only such animals in its herd register as can be traced directly to the island of Jersey. There have been sixty-three volumes of the register published, bringing the records and pedigrees for bulls up to 74,000, and for cows, up to 199,000. To January 21, 1908, 78,855 bulls and 212,515 cows had been registered on the books of the clerk. It is estimated that there are 120,000 registered cattle alive in the United States today, besides hundreds of thousands of grades. The Jersey Bulletin, published at Indianapolis, Indiana, is devoted exclusively to the development of the Jersey cow.

Other organizations are the English Jersey Cattle Society and the New Zealand Jersey Cattle Breeders' Association. The former has published seventeen volumes of its herdbook ; the latter, organized in 1903, has published one volume of its herdbood.

Literature.

John Thornton, History of the Breed of Jersey Cattle, Jersey Bulletin, Vol. 1 (1883); Black, Guide to Brittany (1873); Report of Highland and Agricultural Society of Edinburgh, 1878; Colonel Le Couteur, On the Jersey, Misnamed Alderney Cow, Journal of the Royal Agricultural Society of England, Vol. 5 (1845); C. P. Le Cornu, The Agriculture of the Islands of Jersey, Guernsey, Alderney and Sark, Journal of the Royal Agricultural Society of England, Vol. 20 (1859); Ernest Mathews, The Jersey Cow, Little Shardeloes, Amersham, Bucks ; John S. Linsley, Jersey Cattle in America, New York (1885); W. P. Hazard, The Jersey, Alderney and Guernsey Cow, Philadelphia (1872). [See also page 302.]

Oxen. *Figs. 14, 16. Vol. I, Figs. 126, 127, 178.*

By C. S. Plumb.

The word oxen as used in the United States is generally understood to refer to mature, castrated male cattle used for draught purposes. The term steer is more commonly applied to castrated male cattle fed for food only. In Europe and in New England, the word steer applies to animals not of full maturity. In Friesland it is applied to all bulls. The word ox may be, and is, properly applied to cattle in general, although not usually so used.

History of the use of oxen.

Oxen, as beasts of burden, have been used for centuries. In Biblical times the ox was used to tread out the grain at threshing time, and to haul burdens. In various parts of the world, where domestic animals have been used to till the soil, oxen have been used extensively from time immemorial.

The use of oxen for draught purposes in the more civilized countries has gradually been on the decline. In 1789, George Culley, the noted English stockman, in his "Observations on Live Stock," wrote that much fewer steers were then kept to be oxen than was formerly the case. Two reasons were given for this condition: one, the increased cost of land rent, and the other, the greater slowness of oxen than horses in draught work. Some fifty years later, James Cowie, of Scotland, in a prize essay before the Royal Agricultural Society of England, on the comparative advantages of horses and cattle in farm work, also commented on the falling off in the use of cattle for farm work. In southern Europe, in India and some other regions, however, oxen are yet important beasts of labor.

In America, oxen have been used more extensively in New England farming than elsewhere, but in localities where, fifty years ago, yokes of oxen were common on farms, they are now rare. In general, the horse has replaced the ox. According to J. D. Avery, in the fall of 1907, there were exhibited at the Danbury (Conn.) fair approximately one hundred pairs, including all breeds on the grounds. There were forty pairs of Devons. Within a year or two, as many as fifty to seventy-five pairs of oxen have been employed in some of the large lumber camps in Vermont.

Oxen versus horses.

There are certain arguments in behalf of the use of oxen for labor. They are steady at the yoke, sure of foot in hilly, rough regions, have great draught power, and may be sold to the butcher at a fair price after being fattened, even if eight years or more of age. Previous to the introduction of horse-shoeing, the feet of oxen were more durable than those of horses, and stood the wear of labor better than the feet of horses. The chief objection rests in their slowness and inadaptibility to other work than slow draught. The wider range of use of the horse, with his greater activity, has resulted in the displacement of the ox on the farm and in most lumber camps, where oxen at one time were very popular. Cowie, in commenting on the relative value of oxen and horses writes: *"The farm which I occupy has been tenanted by my ancestors for many generations. At the time of* the Revolution, my great grandfather, and his sons for many years after that, employed twelve working horses and twenty-eight working oxen, one-half of each set being yoked to one plow. I now work the same land to better purpose, I presume, with six horses and two oxen."

Breeds of cattle for oxen.

The different breeds of cattle may be used in draught work, but some breeds seem much better suited to the purpose than others. Devon oxen have long been famous in England and in New England, showing much activity in the yoke, and being known as the quickest walkers in England. Herefords are also noted for draught use, while in Sussex, England, the cattle of this county have been regarded as of exceptional merit for labor. Simmenthaler oxen (Fig. 16) are worthy of special mention. In America, Devons, Herefords, Shorthorns and Holstein-Friesians were used considerably for draught work.

Handling oxen.

While oxen may be broken in to work when two years of age, or thereabouts, they are not regarded as suited for hard work before four years of age. Training, however, may well be begun early.

There are various contrivances for hitching up working oxen, but the customary one is by means of a yoke, with two animals abreast. The yoke consists of a wooden main piece resting on the tops of the necks, with two wooden bows placed about the necks, with the ends of the bows inserted up through the yoke and fastened by pins or otherwise. At the center of the yoke, by means of a staple and ring, the wagon pole or plow chain may be fastened. There are also other methods of fastening or harnessing. In Spanish countries the oxen are fastened at the horns with straps and thongs, making a very undesirable attachment to the line of draught. In times past in England, various forms of harnessing have been used, in which bridles, lines, and tug straps have formed a part.

The driving of oxen is usually conducted with an ox-goad or whip with a long lash. The terms, "gee," meaning right, and "haw," meaning left, are used in driving. Oxen readily turn to the direction indicated, and back or go ahead by the same instructions as are usually given horses. The ox-goad in the hands of the driver, very lightly used, with the aid of the terms above indicated, will enable the driver of a yoke of cattle to go through or around very considerable obstacles.

Oxen are shod with a flat piece of iron on each sole of the divided hoof. One of the familiar sights of the writer's boyhood, was a blacksmith shop, with special frame, where many oxen were shod.

[For additional information about these cattle the reader should consult the articles on Devon, Hereford, Holstein-Friesian, Shorthorn, Simmenthaler and Sussex cattle.]

Red Polled Cattle. Figs. 49, 382, 383.

By *H. A. Martin.*

Red Polled cattle are a dual-purpose breed, ranking very highly in both milk- and butter-production.

Description.

In general, the bull is strong, impressive, low-set and of good carriage, and weighs 1,800 to 2,000 pounds, when mature and finished. The cow is of medium wedge-form, low-set, with top and bottom lines straight, except at flank, and weighs 1,300 to 1,500 pounds when mature and finished. The following standard of perfection, adopted by the Red Polled Cattle Club of America, shows what is desirable and undesirable in the breed.

SCALE OF POINTS FOR RED POLLED CATTLE

For cows

DISQUALIFICATIONS.—Scurs, or any evidence whatever of a horny growth on the head. Any white spots on body above lower line or brush of tail.

Perfect score

1. **Color.**—Any shade of red. The switch of tail and udder may be white, with some white running forward to the navel. Nose of a clear flesh color. Interior of ears should be of a yellowish, waxy color 2
   Objections: An extreme dark or an extreme light red is not desirable. A cloudy nose or one with dark spots.
2. **Head.**—Of medium length, wide between the eyes, sloping gradually from above eyes to poll. The poll well defined and prominent, with a sharp dip behind it in center of head. Ears of medium size and well carried. Eyes prominent; face well dished between the eyes. Muzzle wide, with large nostrils 6
   Objections: A rounding or flat appearance of the poll. Head too long and narrow
3. **Neck.**—Of medium length, clean cut, and straight from head to top of shoulder with inclination to arch when fattened, and may show folds of loose skin underneath when in milking form . 3
4. **Shoulder.**—Of medium thickness and smoothly laid, coming up level with line of back . . . 6
   Objections: Shoulder too prominent, giving the appearance of weakness in heart girth; shoulder protruding above line of back.
5. **Chest.**—Broad and deep, insuring constitution. Brisket prominent and coming well forward . . 10
6. **Back and ribs.**—Back medium long, straight and level from withers to setting-on of tail, moderately wide, with spring of ribs starting from the back-bone, giving a rounding appearance, with ribs flat and fairly wide apart . . . 14
   Objections: Front ribs too straight, causing depression back of shoulders. Drop in back or loin below the top-line.
7. **Hips.**—Wide, rounding over the hooks, and well covered 3
8. **Quarters.**—Of good length, full, rounding and level; thighs wide, roomy and not too meaty . 6
   Objections: Prominent hooks and sunken quarters.
9. **Tail.**—Tail-head strong and setting well forward, long and tapering to a full switch 2
10. **Legs.**—Short, straight, squarely placed, medium bone 3
    Objections: Hocks crooked; legs placed too close together.

SCALE OF POINTS FOR RED POLLED CATTLE, continued

For cows Perfect score

11. **Fore-udder.**—Full and flexible, reaching well forward, extending down level with hind-udder 10
12. **Hind-udder.**—Full and well up behind 10
13. **Teats.**—Well placed, wide apart and of reasonably good size 4
    Objections: Lack of development, especially in forward udder. Udder too deep, "bottle shaped" and teats too close together. Teats unevenly placed and either too large or too small.
14. **Milk veins.**—Of medium size, full, flexible, extending well forward, well retained within the body; milk wells of medium size 6
15. **Hide.**—Loose, mellow, flexible, inclined to thickness, with a good full coat of soft hair . . . 5
    Objections: Thin, papery skin or wiry hair.
16. **Condition.**—Healthy; moderate to liberal flesh evenly laid on; glossy coat; animal presented in good bloom 10

Perfection 100

For bulls

DISQUALIFICATIONS.—Scurs, or any evidence whatever of a horny growth on the head. Any white spots on body above lower line or brush of tail.

Perfect score

1. **Color.**—Any shade of red. The switch of tail may be white, with some white running forward to the navel. Nose of a clear flesh color. Interior of ears should be of a yellowish, waxy color 2
   Objections: An extreme dark or an extreme light red is not desirable. A cloudy nose or one with dark spots.
2. **Head.**—Wide, strong and masculine, relatively short. Poll stronger and less prominent than in cow. Ears of medium size and well carried; eyes prominent; muzzle wide with large nostrils 12
   Objections: Long, narrow, or lacking in masculine character.
3. **Neck.**—Of medium length, full crest, of good thickness, strong, of masculine appearance . . 5
4. **Shoulder.**—Of medium thickness and smoothly laid, coming up level with line of back . . . 8
   Objections: Shoulder too prominent, giving the appearance of weakness in heart girth; shoulder protruding above line of back.
5. **Chest.**—Broad and deep, insuring constitution. Brisket prominent and coming well forward . . 12
6. **Back and ribs.**—Back medium long, straight and level from withers to setting-on of tail, moderately wide, with spring of ribs starting from the back-bone, giving a rounding appearance, with ribs flat and fairly wide apart 14
   Objections: Front ribs too straight, causing depression back of shoulders. Drop in back or loin below the top-line.
7. **Hips.**—Wide, rounding over the hooks, and well covered 3
8. **Quarters.**—Of good length, full, rounding, and level; thighs wide and moderately full, deep . 6
   Objections: Prominent hooks, sunken quarters.
9. **Tail.**—Tail-head strong and setting well forward, long and tapering to a full switch . . . 2

SCALE OF POINTS FOR RED POLLED CATTLE, continued

For bulls	Perfect score
10. **Legs.**—Short, straight, squarely placed, medium bone	3
Objections: Hocks crooked; legs placed too close together.	
11. **Rudimentaries.**—Large, wide apart, and placed well forward	12
Position of rudimentaries	6
Objections: Rudimentaries placed back on scrotum, or placed too close together, indicating tendency to transmit badly formed udders.	
12. **Hide.**—Loose, mellow, flexible, inclined to thickness, with a good full coat of soft hair . . .	5
Objections: Thin, papery skin or wiry hair.	
13. **Condition.**—Healthy; moderate to liberal flesh evenly laid on; glossy coat; animal presented in good bloom	10
Perfection	100

History.

Hornless or polled cattle have existed in the county of Suffolk, England, from time immemorial. The probability seems to be that they were introduced soon after the Roman occupation. Bede says that the people who settled in eastern England after the Romans had gone, brought with them slaves, their cattle, and all their live-stock. Certain it is the breed has existed in Suffolk as far back as we can trace the history.

Of the Norfolk strain of the breed, Mr. H. F. Euren, in the account prepared for the herdbook, says: "The files of the Norwich Mercury show that as early as the year 1778, there were whole dairies of polled cows in Norfolk." In the advertisements of that and succeeding years, sales of polled cows and bulls are specially referred to. Mr. Money Griggs, of Gately, who died in 1872, in his hundredth year, and who had been for upwards

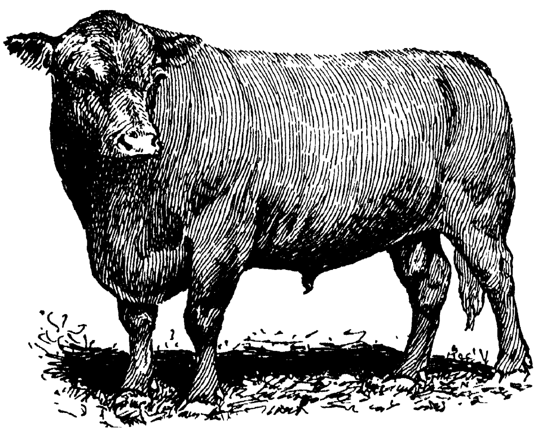

Fig. 382. Red Polled bull.

of eighty years, a tenant of the Elmham estate, informed Mr. Fulcher, when making inquiries as to the breed, that "from his earliest recollection Red Polled cattle had been kept in the neighborhood of Elmham."

In America.—There seems little doubt that our so-called native muley cows are descendants, more or less mixed with other strains, of the Norfolk and Suffolk cows brought over by the early emigrants from that section. They have been preserved from extinction by the persistence of their good qualities. The persistence with which the old Suffolk traits are transmitted, under what would seem most adverse conditions, finds a striking illustration in what were known in Massachusetts as Jamestown cattle. In 1847, during the famine in Ireland,

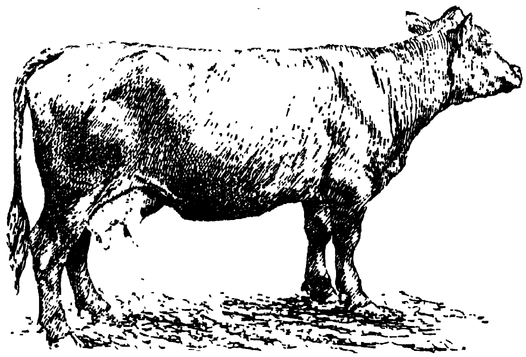

Fig. 383. Red Polled cow. Olena.

the people of Boston sent a shipload of provisions to that country to relieve the distress. As a slight token of appreciation, a Mr. Jeffries, living near Cork, presented to the captain a Suffolk polled heifer. She was delivered by him to the donors of the provisions, and was sold at auction for the benefit of the fund. She proved a remarkably fine milker, and her progeny (mostly bulls, by what were then known as Alderney sires) were used largely in the dairy herds about Boston. The progeny of these half-blood Suffolk bulls were nearly all hornless, and were so superior to the ordinary cattle of the district as to become noted. They were known as Jamestown cattle, from the name of the vessel in which the heifer came over. At several local fairs they were shown in considerable numbers.

The first regular importation of Red Polled cattle for breeding purposes was made by G. F. Taber, of New York, in 1873. This importation consisted of a bull and three heifers. In 1875, he imported four more cows, and in 1882, three bulls and twenty-three heifers. From this time, the number brought over increased rapidly from year to year, until the prices on the other side became so high that the business was unprofitable.

Distribution.

In England, we find the Red Polled cattle in their native counties of Norfolk and Suffolk. They are also found in South America, Australia, Russia, South Africa, New Zealand, Canada and the United States. In America we find the greatest number of Red Polled cattle in the Mississippi valley, in the states of Ohio, Indiana, Illinois, Wisconsin, Michigan, Minnesota, Iowa, the Dakotas, Kansas, Nebraska and Missouri. We also find them on the Atlantic coast, the Pacific coast and in Texas. In

Plate XII. Shorthorn (or Durham) bull and cow

the last-named place they are very numerous and do exceptionally well.

Types.

Suffolk Red Polled cattle.—This type was characterised by a thin, clean head; clean throat with little dewlap; thin legs; a large frame; rib tolerably springing from the center of the back, but with a heavy barrel; back-bone ridged; udder large, loose and creased when empty; milk veins remarkably large, and rising in knotted puffs. It was the dairy type, and was remarkable for the large and uniform yield of milk. It was developed in the county of Suffolk, England, at a very early date.

Norfolk Red Polled cattle.—This type was characterized by small bones, short legs and round barrel, with good loins, and the head rather fine. It was a hardy, thriving strain, maturing at an early age and making a superior quality of flesh. It was the beef type and had poor milking qualities. It was developed at an early date in Norfolk county, England.

Breeders of these two types, striving to produce good dual-purpose animals, that should be polled and red-colored, gradually worked toward the same type. Mr. Euren says: "The year 1846 may be taken as the date from which the Norfolk and Suffolk varieties merged into each other, so as to be spoken of as one and the same breed." There was a friendly rivalry between the two counties at the agricultural shows, and a constant interchange of the best blood, with a resulting improvement and similarity in the two strains. After an exhibit at Battersea in 1862, when it was noted that the best forms of the two types were of the same kind, the name Norfolk and Suffolk Red Polled cattle was given them. Later, about 1882, the first part was dropped, since which time the cattle have been known simply as Red Polled.

Uses.

The Red Polled cattle are a dual-purpose breed, and we find that they have made a large number of very creditable records, both in dairy tests and in slaughter tests.

For milk and butter.—The cows give a good flow of milk, which tests well, and milk right up to calving if allowed. Some results of tests may be given to illustrate this point. The following dairy tests were made at the state fairs the past season (1907). At Ohio State Fair a three-days' test resulted as follows: The cow Queen Bess 20335 gave 99 pounds of milk and 5.316 pounds of fat; the cow Miss McKinley 17203 gave 82.7 pounds of milk and 3.843 pounds of fat; the cow Cassandra 2nd 16305 gave 92.1 pounds of milk and 3.48 pounds of fat. At the Illinois State Fair, in a three-days' test the Red Polled cow Olena 18772 gave 128.4 pounds of milk and 4.533 pounds of fat. The next highest cow of any breed in the show made 4.234 pounds of fat. At the Wisconsin State Fair, in a three-days' test the Red Polled cow Olena 18772 gave 125 pounds and 12 ounces of milk, and made 5.336 pounds of fat.

For beef.—The steers make a good growth, are ready for market at an early age, and furnish a very fine quality of meat. The following slaughter tests, made at the International Live-Stock Exposition show the standing of the Red Polled cattle in meat-production: For two-year-olds (1906), the highest yield was made by an Aberdeen-Angus, dressing 69.5 per cent; the next highest was a Red Polled, dressing 69.2 per cent. For yearlings (1906), the highest yield was a Red Polled, dressing 67.5 per cent; the next highest was a Hereford, dressing 67.1 per cent. For two-year-olds (1907), the highest yield was made by an Aberdeen-Angus, dressing, 66.9 per cent; the next highest was an Aberdeen-Angus, dressing 66.64 per cent; the next was a Red Polled, dressing 66.6 per cent. In this test were fifteen entries.

For crossing and grading, Red Polled bulls have been used extensively and with good results. They transmit the color and polled character uniformly, and may be used profitably on either dairy or beef common stock. They cross well with Shorthorns.

Organizations and records.

The Red Polled Society of Great Britain and Ireland was organized in 1888, at which time it took up the publishing of the Red Polled Herdbook, which had been published by H. F. Euren since 1874. The Red Polled Cattle Club of America was organized at Chicago in 1883. The first volume of its herdbook appeared in 1887, since which time nineteen volumes have been issued. Until 1901, the American Red Polled Herdbook included all of the cattle entered in the English series. At present only cattle grown in this country are published in the American series. There are several state associations in America devoted to the breed.

Literature.

For references, see page 302.

Shorthorn Cattle. Figs. 46, 276, 384, 385.

By *Herbert W. Mumford.*

Shorthorn cattle are a breed possessing both beef and dairy types. Registered and grade cattle of this breed are more numerous than the cattle of any other beef breed. They originated in the valley of the Tees river, in northeastern England, and first became prized by farmers in the shires of Durham, Northumberland, Lincoln, and York. Largely from the localities in which they originated, Shorthorns were formerly called Teeswater cattle and Durhams. These names as referring to Shorthorns have now largely become obsolete.

Description.

The general conformation of the Shorthorn is that of the beef type. The breed is characterized by width and depth of form, great scale and substance, and symmetry and style. It is the largest of the beef breeds. The head should be wide between the eyes, short from eyes to nostril, and while it should be neat and refined, it should indicate good feeding qualities. The horns are short

and rather fine, should curve gracefully forward, and should be waxy white in color, with dark tips. A "spike" horn is objectionable. The neck should be short and fine, and smoothly jointed to the head and shoulders. The shoulders are rather upright, and frequently inclined to be bare of flesh. The back should be straight, level and broad, and deeply covered with flesh. The strong feature in the make-up of the Shorthorn is the hind-quarter, which is said to be the best of any breed. The thighs are wide, deep, and long, and well filled down in the twist. The line of the back of the thigh is nearly straight from the tail down, giving a characteristic squarely built appearance. As a rule, the body is deep, with a good heart and digestive capacity. The flanks should be well let down, making a nearly straight under-line. The legs are medium length and of fine yet strong bone. The breed has a great capacity for the production

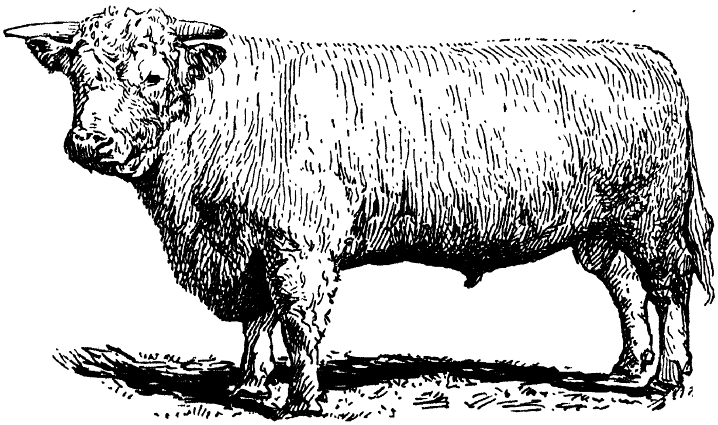

Fig. 384. Champion Shorthorn bull. Whitehall Sultan 163573

of flesh, and as they become fat there is a tendency to produce patches of fat about the tail-head and rolls along the sides.

A criticism of the breed that has been made in the past is that Shorthorns were too long in the legs. There was probably just ground for this criticism in the old type of Shorthorn, but since the breed has received such an infusion of the blood of the low-set, short-legged Scotch type, this tendency has been largely done away with.

The color of the Shorthorn is more variable than that of any other breed of cattle. It may be pure red, pure white, a mixture of these two colors, or roan. Roan is distinctively a Shorthorn color, and may always be regarded as an indication of Shorthorn blood. Red and white were always characteristic colors of the old Shorthorn breed in England, but after their introduction into the United States, white became unpopular, especially on the western ranges, and anything except a solid red color was greatly discriminated against. The demand for red cattle became greater than the supply of good individuals, and sires of very ordinary character were used for no other reason than that they were red, while excellent individuals of the lighter colors were rejected. Good sense and sound judgment finally prevailed in the matter, and the red color craze has abated so that whites and roans have again come into popularity.

No scale of points has been adopted for the Shorthorn breed of cattle.

History.

As has been said, the Shorthorn breed of cattle originated in northeastern England, and first became popular in the shires of Durham, Northumberland, Lincoln and York. From this somewhat restricted territory their popularity gradually extended throughout England and Scotland, until, early in the nineteenth century, they were by far the most popular race of cattle in the British Isles. Authorities differ somewhat as to the particular stock used in developing this breed. All agree, however, that the largest factor entering into their production was the native cattle of the northeastern section of England. That occasional crosses of Dutch bulls were used is probable.

Collings Brothers. — Improvement began about 1750, although very little methodical or efficient work was accomplished prior to the cattle-breeding operations of Messrs. Robert and Charles Collings, of Barmpton and Ketton Hall. By careful selection and inbreeding they succeeded in setting standards towards which contemporary breeders aimed. Charles Collings' first Shorthorn purchase was made in 1784. His herd was dispersed successfully in 1810. Robert Collings' herd was sold partly in 1818 and the remainder in 1820. While these two brothers operated their farms separately and maintained separate herds, their methods and accomplishments were similar. They were unusually fortunate in the purchase of that first great Shorthorn sire, Hubback (319). While this was an undersized bull, yellow-red in color, he proved a fortunate "nick" for the late-maturing, coarse cows so common in the early history of the breed. As breeders of the Durham Ox, The White Heifer that Traveled, Favorite (252) and Comet (155), these pioneer breeders established a reputation for breeding good Shorthorns that has made an impression on every careful student of the early history of the breed.

Other English breeders.— Among others, the following breeders were identified with the early history of the breed: Sir William St. Quintin, Sir James Pennyman, and Messrs. Milbank, Sharter, Pickering, Stephenson, Wetherell, Maynard, Dobinson, Charge, Wright, Hutchinson, Snowdon, Waistell, Richard and William Barker, Brown, Hall, Hill, Best, Watson, Baker, Thompson, Jackson, Smith, Jolly, Masterman, Wallace, and Robertson.

Darlington was for years looked on as the center of Shorthorn interests, although, strange as it may seem, there is but little activity in breeding Shorthorns in that section at the present time.

Thomas Bates of Kirklevington.—Thomas Bates,

who was destined to become such an important factor in the breeding of Shorthorn cattle, purchased his first stock in 1800. He had previously been a breeder of Kyloes or West Highland cattle. He was well prepared for the work he undertook, and established families of Shorthorns of such pronounced individuality and recognized excellence of pedigree that they were at one time by far the most popular strain of the breed. Prices were paid during "boom times" for Bates' Shorthorns that have never been approached by Shorthorns of other lines of breeding. Thomas Bates was a stickler for pedigree. He assumed that cattle bred along certain specified lines would produce, when mated, almost invariably certain desired results. The particular family or tribe which he developed most and favored most was the Duchess. Fabulous prices have been paid for representatives of this family. The highest recorded price, $40,600, was paid for a cow of this family at the New York Mills sale of September 10, 1873.

Belvedere (1706) was one of the best bulls used by Bates, while the Duke of Northumberland (1940), the acknowledged champion bull of England in 1842, was undoubtedly the best bull ever produced at Kirklevington. Bates' aim in breeding was to produce a dual-purpose cow, and as a consequence he gave careful attention to preserving the milking qualities of his Shorthorns. There was a characteristic style and finish about Bates' Shorthorns that still clings to cattle containing a strong infusion of this blood. While cattle of Thomas Bates' breeding were frequently seen in the show-ring from 1838 to 1848, and wherever shown were unusually successful, he was personally very much opposed to training cattle for show. The Bates herd was dispersed in 1850, when prices were very low, and as a consequence the cattle did not bring what they were worth.

The Booths.—The elder Booth was a contemporary of Thomas Bates. His first herd was established at Killerby in 1790. His especial aim was to breed an earlier-maturing beast that would be noted for its beef-producing rather than its milk-producing qualities. While Mr. Booth was very ready to admit that the Collings had greatly improved Shorthorns, he did not think, as many of the breeders of the time apparently thought, that it was necessary to buy the females composing his herd of them. Among his early purchases were five heifer calves from the herd of Mr. Broader of Fairholme. To mate with these heifers, Mr. Booth purchased the Robert Collings bred bull, Twin Brother to Ben (660), and one of his get. Some of the best of the Killerby and Warlaby cattle descended from this line of breeding and from the following tribes or families: Blossom, Bright Eyes, Isabella and the Booth Red Roses. Another bull which was purchased of Robert Collings was Suworow (626), at the dispersion sale of the Ketton Hall herd in 1810. Mr. Booth purchased the bull Albion (14), which proved to be a most excellent sire. Most of his bulls were from the Collings' herds. Besides the families of Shorthorns mentioned, Thomas Booth was partial to the Strawberry and Bracelet tribes. In 1819, Mr. Thomas Booth gave up the Killerby farm and a part of his herd to his son John, and removed to his Warlaby farm, so prominent in Shorthorn history. To another son, Richard, who was on the Studley farm, he had also sold a number of his Shorthorns.

Other families of Shorthorns which should be associated with the Booth families are the Farewells, the Broughton, Dairy Maids or Moss Roses, Gaudy or Lady Betty sort, Mantilinis and Belindas.

Perhaps the three most famous show animals bred by Booth were Bracelet and Necklace, twin heifers, sired by Priam (2452) and Lady Fragrant. The twin cows mentioned proved excellent breeders. The most famous bull used by any of the Booths was Crown Prince (10087), "The bull of all Booth bulls," the one that was to Warlaby what Duke of Northumberland was to Kirklevington, and Champion of England was to Sittyton. Crown Prince was considered too valuable a stock-getter to be fitted for exhibition.

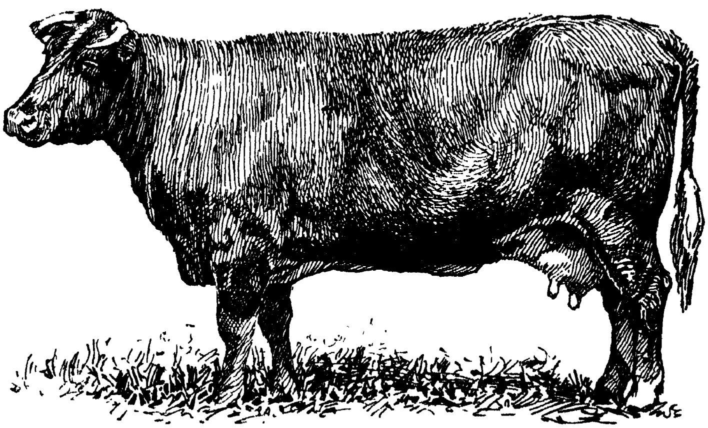
Fig. 385. A typical dual-purpose Shorthorn cow. Gipsy Maid.

The Booth family is still interested in the breeding of Shorthorns and the operations of this family will always remain an interesting chapter in the history of Shorthorns. They were prominent in the leading live-stock shows of the country, and undoubtedly the breeding qualities of many of their best cattle were affected by high feeding for exhibition purposes.

In United States.—The first recorded importation of Shorthorns to the United States was that of Mr. Miller, of Virginia, and Mr. Gough, of Baltimore, Maryland. These gentlemen imported from Great Britain, in 1783, some cattle that were undoubtedly of the Shorthorn breed. In the years 1790 and 1795, it is thought that they brought in consignments of cattle of the same breed. In 1791 and 1796, Mr. Heaton brought several Shorthorns from England to the state of New York, which were lost among the common stock of the country. A Scotch-

man named Cox, brought a Shorthorn bull and two cows to Rensselaer county, New York, in 1815. The first Kentucky importation was made in 1817, by Colonel Lewis Sanders, who purchased through an agent eight Shorthorns and four Longhorns. At about the same time, James Prentice, of Lexington, Kentucky, imported two good Shorthorn bulls.

Importations were brought to the state of Massachusetts in 1817 by Samuel Williams, in 1818 by Cornelius Coolidge. In 1822, Mr. Williams sent over the roan yearling heifer Arabella, by North Star (460). The Arabellas were noted for being heavy milkers, and at one time constituted a large and valuable family. Other Massachusetts importations of an early date were made by Messrs Lee, Orr, Monson, Coffin, Rotch and Silsby. From 1821 to 1828, several unimportant importations were made to New York, Pennsylvania and Maryland. In 1833, Walter Dunn, living near Lexington, Kentucky, imported six head of valuable Shorthorns. Another importation was made by Mr. Dunn in company with Samuel Smith in 1836.

The year 1833 was an important one in Shorthorn history, for it saw the organization of the Ohio Importing Company, "For the purpose of promoting the interest of agriculture and introducing an improved breed of cattle." Felix Renick was chosen as the agent of this company to go to England to select cattle for the company. While it was not restricted to purchase all Shorthorns, it decided, after considerable investigation, to import only Shorthorns. Among the herds visited were those of Maynard, Booth, Bates, Whitaker, Althrope, Craddock, Raine and Paley. Seven bulls and twelve females were carefully selected for the first importation. In this lot were the two heifers, Rose of Sharon and Young Mary, which were destined to play such an important part in the history of Shorthorns in the United States. This importation was so satisfactory to the shareholders of the Ohio Importing Company that their agent was soon authorized to make arrangements for further importations. In 1835 and 1836, Mr. Whitaker, through Mr. Renick's authorization, sent out two shipments comprising forty-two animals to the Ohio Importing Company. Among these were Josephine, Young Phyllis, Illustrious, and Harriet. In August, 1836, this company held a sale on Felix Renick's farm in Rose county, Ohio. Forty-three animals were sold at an average price of $803.25, or a total of $34,540. The final dispersion sale of the company was held in 1837, at which the fifteen animals averaged $1,071.65. A number of importations were made to Ohio from 1836 to 1840. In 1839, the Kentucky Importing Company brought over a number of Shorthorns.

From 1840 to 1850, agriculture in the United States was in a very depressed state, and the cattle industry, along with other farm interests, remained practically at a standstill. There was little demand for breeding cattle, which resulted in large numbers of Shorthorn breeding stock finding their way to the shambles. In 1852, the Scioto Valley Importing Company was organized. This company, through its agents, George W. Renick and Dr. Arthur Watts, imported ten bulls and seventeen females, which were sold at auction at the very high average of $1,351.85. This sale proved a stimulus to Shorthorn-cattle-breeding interests, and other importing companies were quickly organized, among which were the Madison County, Ohio, the Northern Kentucky, and the Scott County Importing Companies, the Clinton County, Ohio, and Clark County, Ohio, Associations.

In 1852 and 1853, Mr. A. J. Alexander of Kentucky, who was visiting in Great Britain, laid the foundation of the Woodburn herd of Shorthorns. The first shipment of cattle to the Alexander farm was made in 1853; subsequently other importations were made, which included Duchess Airdrie, Duchess Athol, Pearlette, Victoria 20th, Filigree, Lady Gulnare, Minna, Constance, Rosabella, and other cows. Three of the leading bulls imported were Duke of Airdrie, Second Duke of Athol and Dr. Buckingham. At the Northern Kentucky and Scott County Companies' sales, Mr. Alexander made important purchases in the cows Mazurka, Maid of Melrose and Equity. The Woodburn herd took a prominent place in Shorthorn affairs and was at one time probably one of the largest and best Shorthorn herds in America if not in the world. The Duke of Airdrie (12730) was used a year by George M. Bedford and to some extent by Abram Renick and Jere Duncan, as well as by Mr. Alexander. Bell Duke of Airdrie 2552, Duncan's Duke of Airdrie 2743, and Airdrie 2478 are considered among this great bull's most famous sons.

Among the most prominent breeders of Shorthorns in the United States at this early period should be mentioned Abram Renick of Kentucky. Perhaps the most far-reaching accomplishment of his efforts is to be found in the founding and bringing to a high degree of excellence that family that for many years attracted international attention, viz., the Rose of Sharon. The bull Airdrie 2478, already mentioned, was spoken of as one of medium size, very symmetrical, neat, smooth and stylish, and a remarkable sire of high-class bulls. This bull was used extensively in Mr. Renick's herd and sired, among other famous Shorthorns, the bull Sweepstakes 6230, Joe Johnson, Airdrie 3d 13320, Dick Taylor 5508, and Airdrie Duke 5306. It was with the get of Airdrie that Mr. Renick began his system of in-and-inbreeding, producing the Rose of Sharons that called forth the admiration and respect of the entire Shorthorn-breeding fraternity.

Even a brief history of Shorthorns should not omit the name of Warfield. Benjamin Warfield secured his first pure-bred Shorthorn in 1831. The first great sire in the herd was Renick 903. He was noted more as a sire than for his individual excellence. Benjamin Warfield was succeeded by his son, William Warfield, of Grasmere. One of the famous bulls used by Warfield was Muscatoon 7057. This bull proved to be not only an excellent show bull but a sire of superior show animals. Mr. William Warfield originated the Loudon Duchesses, by many persons thought to be one of the best tribes of Shorthorns evolved in America.

Several importations were made into the eastern part of the United States from 1830 to 1860. This stock was very largely of the Bates strains. Perhaps the most important importations during this period were by Mr. Samuel Thorne, of Thorndale, New York. His first importation was followed by others in 1854, 1855 and 1856. These constituted the highest-priced cattle that had thus far been brought to the United States. In 1857, Mr. Thorne purchased the Morris and Becar herd, consisting of fifty-three Shorthorns, at the reported price of $35,000.

While the principal importations were confined to Kentucky, Ohio, and New York, Shorthorn activity was apparent elsewhere, notably in Illinois, Indiana, Michigan, Missouri and Iowa.

In Canada.—In 1833, Mr. Roland Wingfield, near Toronto, imported two Shorthorn bulls and five cows from England. Other early importations were made by the Home District Agricultural Society, Adam Furgeson, Messrs. George and John Simpson, William and George Miller and Frederick William Stone. It may be said, however, that the Shorthorns were not imported extensively to Canada until Scotch Shorthorns came into popularity. Messrs. George and William Miller, Simon Beattie, George Isaac and M. H. Cochrane were first responsible for Shorthorn activity in Canada.

The first Canadian to bring Scotch cattle into prominence in America was Mr. Joseph S. Thompson, Mayfield, Whitby, Canada. He imported the Champion of England heifers, Sylvia and Christobel, also Violet 4th. Mr. James I. Davidson, Balsam, Ontario, was also one of the early and most ardent supporters of the Scotch type in Shorthorns. He started his Shorthorn herd in 1860. From 1881 to 1887, practically all the stock from the Sittyton herd that was brought to the United States passed through the hands of Mr. Davidson. Hon. John Dryden, Brooklyn, Ontario, founded the Maple Shade Farm herd of Shorthorns, in 1871. He imported that famous Champion of England cow, Mimulus, and other good ones representing the best of the Sittyton blood. Hon. George Brown, of Bow Park farm, will go down in history as a prominent factor in Canadian Shorthorn activity. Among other Canadian breeders and importers were John M. Armstrong, Arthur Johnson, W. B. Telfar, W. Major, William Collum, Thomas Russell, Francis Green and George Whitfield.

Important events in Shorthorn history since 1860.—In 1869 and 1870, Messrs. Walcott and Campbell, of New York, imported Booth Shorthorns and the entire Sheldon herd of Duchesses and Oxfords. This was the beginning of the greatest boom in Bates cattle in the United States. In 1867, Col. W. S. King, of Minneapolis, Minn., founded his important herd in the northwest. From 1860 to 1880, Shorthorns of Bates families were undoubtedly preëminently popular in the United States. In Canada, however, Scotch Shorthorns were gaining in popularity.

The first sale of cattle ever held in Dexter Park, Chicago, was in the year 1872. These were prosperous times for Shorthorn breeders. This prosperity extended into the next year and culminated in one of the greatest if not the greatest public sales of pedigreed cattle held in the world, namely, the New York Mills sale of Walcott and Campbell, September 10, 1873. This herd contained the only living Duchesses which were descended direct from the Bates herd without the admixture of blood from other sources. The sale was very largely attended by Shorthorn fanciers from Great Britain, Canada and the United States. At this sale the eighth Duchess of Geneva brought $40,600, and many others were sold at fabulous prices. Almost immediately following this sale there came a period of financial depression, and Shorthorn cattle gradually decreased in value for a few years.

Popularity of Scotch Shorthorns.—Undoubtedly the most notable feature of Shorthorn history from 1880 to the present time has been the growing popularity of Scotch Shorthorns. Of all the breeders of Scotch Shorthorns, Amos Cruickshank is looked on as the most famous. He was an Aberdeenshire tenant farmer, who thought that Shorthorns had been too much pampered for practical use on the tenant farms of Scotland, where climatic conditions made it necessary for the farmers to choose a hardy race of cattle. He was a lover of Shorthorns, and determined to develop a type that would meet the requirements of the farmers of Scotland. His ideal was a short-legged, broad, thick-fleshed beast, carrying a good middle; that is, a well-sprung rib and a thick, fleshy back and loin. He selected animals of this type with which to found his herd, and was so successful that his herd soon became recognized as the foremost one of Scotland. His brother, Anthony, was associated with him. Mr. Cruickshank got a very strong hold on Shorthorn breeders, that remains to this day. To such an extent is this true that one Shorthorn may be two to five times more valuable than another of equal individual merit, simply because it has a good Scotch pedigree and the other has not.

Among those who have helped to popularize Scotch Shorthorns in America may be mentioned Col. W. A. Harris, of Linwood, Kans., J. J. Hill, of St Paul, Minn., and Col. T. S. Moberly, of Richmond, Ky. Many other names might be added.

Distribution.

The Shorthorn is the most widely distributed breed of cattle. It is found in Europe, especially in Great Britain, in Asia, South Africa, Australia, North and South America. It is the most popular and most widely distributed beef breed of cattle in the United States and Canada, and is found in every state and province in these two countries. In the United States, Shorthorns are found most numerously in the following states, in order of their importance: Iowa, Missouri, Illinois, Ohio, Indiana, Kansas, Nebraska, Minnesota, Michigan. They are still growing in popularity.

One feature which adds greatly to the popularity of the Shorthorns is their great adaptability. They have the power to adapt themselves to varying conditions of food, climate and treatment. Although

they are best adapted to temperate regions, they readily adjust themselves to greater extremes of temperature and climate. They possess a fair degree of hardiness, and do fairly well under range conditions. The Shorthorn was the first breed used for the improvement of the cattle on the ranges, and has been used extensively for this purpose in the United States, Argentina and Australia, but in recent years has been largely supplanted by the Hereford. Notwithstanding its value on the range, the Shorthorn is best adapted to a system of mixed farming, such as is followed in the Mississippi valley, where land is so valuable that a cow cannot be kept for the calf alone, but must yield a profit in the dairy. Mr. George M. Rommel, in Bulletin No. 34, Bureau of Animal Industry, United States Department of Agriculture, states that, of the 150,000 registered Shorthorns estimated to be living in America, 5 per cent are found on the range, and the other 95 per cent are in the hands of the small farmer.

Uses.

For milk.—The Shorthorn ranks high in its dairy capacity. In England there have always been families or strains, notably those of Bates breeding, which have been noted for their milking capacity, and in England today the dairy qualities of the Shorthorn receive as much consideration as its beef-producing qualities. It is asserted that 90 per cent of the milk-supply of London is furnished by Shorthorns. In America, more attention has been paid to the beef side of the question, and the dairy qualities have been somewhat neglected, especially during the past craze for the thick-fleshed, blocky Scotch type, which were poor milkers. At present, however, more and more attention is being paid to the milking qualities of the breed, and efforts are being made to develop milking strains of Shorthorns.

Major Henry E. Alvord, in Farmers' Bulletin No. 106, United States Department of Agriculture, gives some performances of Shorthorn herds and individuals as follows: "Records of several dairy herds in the United States, within a quarter of a century, show a milking season of about 275 days and an average product of 6,500 pounds of milk. One herd of ten cows, three to twelve years old, averaged 7,750 pounds in a year. Single cows have averaged much more, several instances being known of 10,000 to 12,000 pounds in a season. The Shorthorn milk is of good quality, rather above the average; the fat globules are of medium and fairly uniform size, so that cream separates easily; it is rather pale in color. In 1824, a cow near Philadelphia made over twenty pounds of butter in a week without special feeding. Herds of forty cows have averaged 209 pounds of butter in a year; the herd of ten cows mentioned above averaged 325 pounds, and single cows have records of 400 pounds and over, one being of 513 pounds."

For butter.—The Shorthorns made a very creditable showing in the butter tests against the leading dairy breeds, the Jerseys and Guernseys, at the World's Columbian Exposition at Chicago, in 1893. In the ninety-day butter test, the best Shorthorn cow, Nora, produced 3,679.8 pounds of milk, from which was made 160.57 pounds of butter, and during the period she gained 115 pounds in weight. The best Jersey, Brown Bessie (Fig. 381), produced 3,634 pounds of milk, from which was made 216.66 pounds of butter, and gained 81 pounds. In this test the showing made by the Shorthorn was very good, considering the fact that not nearly so much care and money were spent in selecting the herd as was done with the Jerseys and Guernseys.

For cheese.—At the same time, the Shorthorn made a like creditable showing in a 14-day cheese-making test. In this, the Shorthorn ranked third against the Jersey and Guernsey, yielding 12,186.9 pounds of milk, which made 1,077.6 pounds of cheese. Nora, a Shorthorn, ran second to a Jersey, making 60.56 pounds of cheese at a net profit of $6.27.

For beef.—For the production of beef, the Shorthorn stands second to no breed, and there are very few that equal it. Its popularity as a beef breed both in England and the United States is shown by the number of its representatives found at the leading fat-stock shows of these two countries. The Shorthorn is naturally thick-fleshed, with a maximum development of the valuable parts of the carcass, which causes it to dress out a high percentage of carcass to live weight, although it is not so good in this respect as the Aberdeen-Angus. The Shorthorn is a good feeder, and, when supplied with an abundance of food, makes large gains, yielding good returns for the food consumed. The breed matures early and can be made ready for the block at two to two and one-half years of age; but, if so desired, it will stand a longer period of feeding. When forced for a long time, there is a tendency to take on flesh unevenly, with the fat in patches or rolls on the rump and along the sides.

For crossing and grading.—No other breed has been used for grading up common cattle to the extent that the Shorthorn has, and marked improvement has resulted wherever this method of grading has been followed, as may be seen by noting the improvement that has followed the use of Shorthorn bulls on our western ranges. In our American cattle markets, grade Shorthorns predominate over all other breeds in numbers. The first cross of a Shorthorn on any of the beef breeds makes a good beef animal. The "prime Scots," which are so popular in the English markets, are crosses of the Shorthorn and Aberdeen-Angus. The "blue-gray" steers, which are also highly prized in the British markets, are crosses of the light-colored Shorthorns on the Galloway.

Organizations and records.

In 1822, George Coates, of Yorkshire, England, published the Shorthorn Herdbook, the first registry of live-stock to be issued. From this developed the English Shorthorn Herdbook (Coates' Herdbook), of which fifty volumes have now been published. Since 1876, it has been in the hands of the Shorthorn Society of the United Kingdom of Great Britain and Ireland.

The work of recording Shorthorns in America was first taken up by Mr. Lewis F. Allen, of Black Rock, New York, who published the first volume of the American Shorthorn Herdbook in 1846. Mr. Allen continued this publication as a private enterprise until 1882, when it was purchased by the American Shorthorn Breeders' Association. In 1869, Mr. A. J. Alexander, of Woodburn, Kentucky, published the first volume of a herdbook known as the American Shorthorn Record. In 1878, the Ohio Shorthorn Breeders' Association published the first volume of the Ohio Shorthorn Record, two more volumes of which were published later.

The registration of Shorthorns in the United States at present is conducted entirely by the American Shorthorn Breeders' Association, organized in 1882. This association purchased the interests of all the Shorthorn herdbooks in the United States, and continued the publication, beginning with Volume 25 of the American Shorthorn Herdbook started by Mr. Lewis F. Allen. Sixty-nine volumes of this herdbook have been published, and Volumes 70, 71 and 72 are now in preparation, two volumes being published annually. Up to the close of Volume 69, there are registered about 273,000 males and 421,000 females, making a total of about 694,000.

The first Shorthorn herdbook in Canada was the Canadian Shorthorn Herdbook, the first volume of which was published in 1867. In 1881, the first volume of the British-American Shorthorn Herdbook was published, and the first volume of the Dominion Herdbook appeared in 1887. The latter took over the interests and records of the first two herdbooks, and now the registration of Shorthorns in Canada is through the Dominion Herdbook.

POLLED DURHAM CATTLE. Fig. 386.

Polled Durhams, as a breed, have the unique distinction of being the only breed of cattle originating in the United States. They are very similar to the Shorthorn, and, in fact, the Shorthorn is chiefly responsible for their origin.

Description.

Like the Shorthorn, the Polled Durham is massive in size, quiet in disposition, and a breed well calculated to meet the requirements of farmers wanting a hornless race of dual-purpose cattle. They are, however, better fitted to give satisfaction as beef-producers than in the dairy. During the early history of the breed much attention was paid to color and milking qualities. Red was preferred, but in later years roans have come to be looked on with more favor. With the increase in numbers comes the opportunity to make more careful selections, and the breed is making rapid advancement both in real merit and public esteem. It possesses considerable prepotency.

No scale of points for judging Polled Durham cattle has been adopted. Nearly all Polled Durhams that are being recorded at the present time are pure Shorthorn in blood, and breeders are striving to produce, as nearly as possible, the ideal Shorthorn, minus the horns. Polled Durhams are judged by the same standards as are Shorthorns, and in nearly all large shows Polled Durhams are judged by a Shorthorn breeder.

Distribution.

Herds of Polled Durhams are more numerous in Indiana, Iowa, Ohio and Illinois than in other states, although they are being introduced rather extensively into other sections of the country, notably in North Dakota, Kansas, Kentucky, Wisconsin Texas and Nebraska. Several have been shipped to the Argentine Republic, in South America.

Types.

There are two somewhat distinct lines of blood to be found among Polled Durhams. These are designated as Double-Standard and Single-Standard Polled Durhams.

Double-Standard Polled Durhams include the hornless Shorthorns that are eligible for record in the American Shorthorn Herdbook, as well as the American Polled Durham Herdbook. They are the result of retaining, as breeding animals, hornless Shorthorns, which occasionally appear as freaks in Shorthorn herds. The most of the Double-Standard Polled Durhams are from the three families, White Roses, Young Phyllis and Gwynne's.

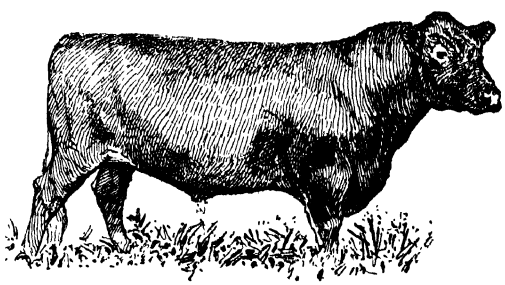

Fig. 386. Young Polled Durham bull.

Single-Standard Polled Durhams are eligible for record in the Polled Durham record only. This branch of Polled Durhams originated by the attempts on the part of a number of breeders, working, at first largely independently, to develop a race of hornless cattle with the characteristics of the Shorthorn breed. This was accomplished by the use of Shorthorn bulls on the native muley cows.

Breeders of note.

Among the early breeders interested in the development of the Polled Durham breed the following were most prominent: William W. Crane, Tippecanoe City, Ohio; W. S. Miller, Elmore, Ohio; J. F. and A. E. Burleigh, Mazon, Illinois; and Shafor and Clawson, Hamilton, Ohio.

Organizations and records.

The American Polled Durham Breeders' Association, which has for its object the furthering of the interests of the breed, and the recording of animals eligible to its herdbook, was organized in Chicago,

November 13, 1889, and was chartered November 2, 1890. Three volumes of the American Polled Durham Herdbook have been published, the first having appeared in 1894. "Animals to be eligible to entry in the American Polled Durham Herdbook must be at least six months old; must be naturally hornless; must have both parents recorded therein or have one parent recorded in the book and the other parent recorded in the American Shorthorn Herdbook; and further, must have all ancestry that are eligible recorded in the American Polled Durham Herdbook."

Literature.

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Sussex Cattle. Figs. 387, 388.

By *Overton Lea.*

Sussex cattle are so called from the county of that name in England, where they most abound. They are distinctly a beef breed.

Description.

For a short description, by way of comparison, imagine a Devon with the weight of a Shorthorn, and the picture will convey an accurate idea of the Sussex. More particularly, "the horns are of medium length, coming out at any angle, but generally horizontally, branching laterally, and turning upward toward the ends; nose tolerably wide, with muzzle of flesh-color; thin between the nostrils

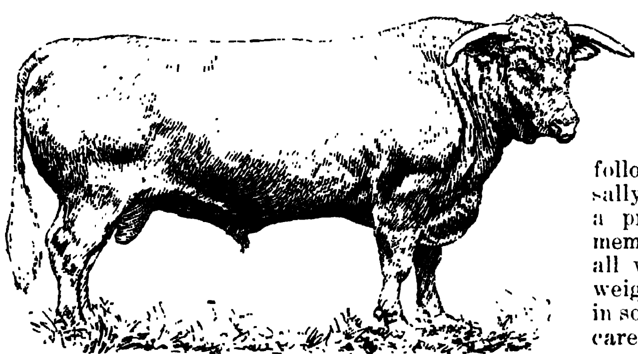

Fig. 387. A Sussex bull.

and eyes; eyes rather prominent; forehead inclined to be wide; neck short; sides straight; wide and open in the breast, which should project forward; girth deep; legs short; chine-bone straight; ribs broad; loin full of flesh; hip-bone not very large, and well covered; rump flat and long; tail with white brush, which should drop perpendicularly; thigh flat outside and full inside; coat soft and silky, with a mellow touch; color solid red, both light and dark, sometimes the two shades mingling and making a beautiful dappled bay; and a few gray or white hairs, nearly always single, except on the foretop, are regarded most favorably."

The special merits claimed for the breed are large size, early maturity, propensity to fatten,

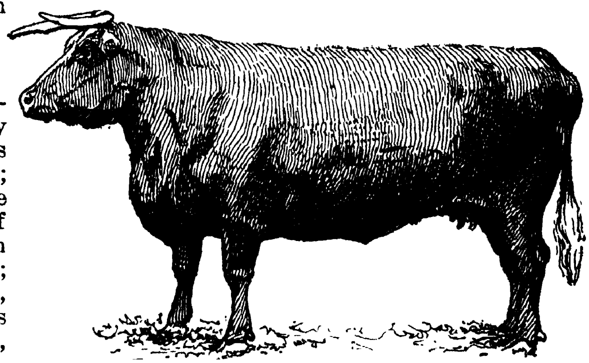

Fig. 388. A Sussex cow.

prime quality of flesh laid on the most desirable parts, hardihood of constitution, uniform popular color and capacity to impress these characteristics on their offspring.

The American Sussex Cattle Association has never adopted a scale of points for judging this breed.

History.

The origin of the Sussex, like that of all the oldest breeds of English cattle, is involved in obscurity. According to Youatt and Martin, some of the ancient Britons fled before the advance of their enemies to the Weald of East Sussex and carried with them their cattle, or found there some of the native cattle of the country, and zealously guarded them against all admixture. Mr. Alfred Heasman, editor of the first three volumes of the Sussex Herdbook, and author of a chapter on Sussex cattle in "The Cattle of the British Isles," doubts whether the breed was imported or found native to the country on the advent of William the Conqueror and his followers. Be this as it may, the breed is universally recognized to be a distinct one. It has been a prominent feature of Sussex from time immemorial, and has preserved, unchanged through all vicissitudes, the same characteristics,—great weight, aptitude to fatten, and red color,—except in so far as improved by better feeding and greater care. Originally they were used chiefly for draft purposes, their great size and strength and activity, withal, enabling them to draw promptly the heaviest loads and till the stiffest soil. But, even in remote times, the quality of their flesh was highly prized and, when the oxen became aged, they were bought up, grazed a year, and supplied the markets with animals weighing 180 to 200 stone (a stone

is about 14 pounds avoirdupois, making the weight 2,500 to 2,800 pounds.)

These cattle have always been the favorite of the tenant farmer (than whom there is no better judge of a profitable animal) of Sussex and adjacent counties, and have constituted for many years one of the chief attractions at the local stock shows. More recently, stimulated by the exportation of large numbers of the principal breeds at fancy prices, some of the English breeders have sought to bring forward the Sussex more prominently at all of the leading shows of the British Isles; nor are they strangers in the show-yards on this side of the Atlantic. Most gratifying success has crowned these efforts both abroad and here, as may be seen from the files of the English and American agricultural press for the past quarter of a century.

In America.—The date of the first importation to America is uncertain. The characteristics of many of the so-called native red cattle, found in New England and in Tennessee on and near Cumberland plateau, and, perhaps, in other states, suggest that they, in common with almost all species and breeds of domestic animals, were brought over by the early colonists. Since 1880, a number of importations have been made, and the Sussex are domiciled on many farms and scattered over the ranges, doing their full share toward the improvement of the native cattle. In 1884, the writer imported a number of this breed of cattle for his farm in Tennessee. In 1891, the Ontario Agricultural College at Guelph, Canada, made an importation.

Distribution.

Sussex cattle are not yet widely distributed. Their local habitat is Sussex and the adjoining counties in England. They have been exported to Canada and the United States, and, as stated in the agricultural press, to South Africa, Egypt, and, perhaps, to South America also. As far as known they have thrived wherever tried, and it may be stated safely that they will do well wherever any of the bovine species can be produced successfully. Cattle from the herd of the writer have been distributed to several parts of Tennessee, and to Alabama, Arkansas, South Carolina and Texas. Other herds are found in Maine, Indiana and Illinois.

Feeding and care.

The breed responds as generously as any to full feeding and care, and thrives on rough and scant pasturage. In cold weather, shelter—the lee side of a shed, or wind-shield, or straw-stack, if no better is obtainable—is a distinct advantage; at other seasons, nothing but fair grazing is required.

Uses.

For milk.—As the Sussex is primarily a beef breed, its milk-giving qualities have not been especially developed. At the same time, the cows, almost without exception, give milk of most excellent quality and, if milked closely, make surprisingly good dairy animals. They fatten when dry more readily, perhaps, than the ox.

For beef.—The Sussex has achieved the highest honors "on the scale and the block." The object of the breeders, as a class, revealed by the typical Sussex of today, has been to produce the most profitable butcher's beast; to hasten the period of maturity and improve the quality, without forgetting for a moment to preserve these most excellent characteristics of the breed,—sound constitution, capacity "to rustle," fecundity and prepotency. The Sussex makes large and rapid gains, and attains great weight. About 1,500 pounds for cows and 2,000 pounds for bulls represent the average weights of animals in good breeding condition. The average weight of a well-fatted bullock, twenty-four months old, may be safely put at 1,400 pounds.

For grading.—The prepotency of Sussex bulls makes them valuable for crossing on native or grade stock, to improve the beefing qualities and ability to graze. They readily stamp their characters on their crosses.

Organizations and records.

At a comparatively early date in the history of registration, the English Sussex Herdbook Society established the English Sussex Herdbook, tracing pedigrees to the year 1855. The American Sussex Register was established in 1889 by the American Sussex Cattle Association. Comparatively few Sussex cattle have been imported to the United States, and only one volume of the Register has been published (1906), containing something less than 300 entries.

Literature.

Arthur Young, General Views of Agriculture in the County of Sussex (1793). [For further references, see page 302.]

Some of the Lesser Known Breeds of Cattle. Figs. 389–394.

By *C. S. Plumb.*

A larger number of breeds, or so-called breeds, of cattle exists than is commonly supposed. In various sections of Europe, for many years the inhabitants have bred and developed breeds that seemed especially adapted to the local environment. This condition exists even today, to such a degree that one finds breeds of merit, yet of limited distribution, in various districts of Great Britain and on the continent of Europe. Among the lesser known, yet valuable breeds, may be mentioned the Black Welsh, Brahmin or Sacred, Breton or Brittany, Kerry, Longhorn, Normandy, Simmenthal, and West Highland. All excepting the Black Welsh and Longhorn have been introduced to some extent into America. These breeds, however, are very rare in this country. In America, there is also the Texas Longhorn type, which is fast passing, but which has filled an important need.

Black Welsh Cattle. Fig. 389.

Black Welsh cattle are found principally in Wales, and are of obscure ancestry. They have been regarded as of aboriginal ancestry and have

numerous characteristics in common with the West Highland breed. Black, horned cattle are found in both North and South Wales, and represent two different types. They resemble each other to a considerable extent, but those of South Wales are distinctly coarser and larger than those of North Wales. Those of the south are not popular in the north. Some of the special characteristics are a black color, although brownish black or reddish black sometimes prevails. White hair rarely occurs, excepting on the udder of the cow, the scrotum of the male and the brush of the tail. The horns are rather prominent, being yellowish white with blackish tips, and somewhat wide-spreading and carried forward with the bull, and narrower and more upright with cows. These cattle are beefy in type, and are inclined to be well-fleshed. They are criticized for slackness of loin, flatness of rib and prominence of rump. The temperament is somewhat lively.

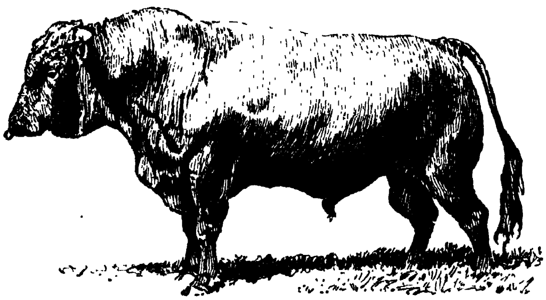

Fig. 389. Black Welsh bull. Prize winner at Royal Agricultural Society Show.

These cattle are indigenous to a hilly grazing country, and are particularly adapted to grazing purposes. They are rarely stable-sheltered in winter and depend on pasturage for food the year round. As a result of this open method of life, the breed is a very hardy one. When kept on the uplands with sparse herbage, the cattle tend to be somewhat smaller than those on the richer lowlands. They are also somewhat slow to mature. Some specimens of the breed attain considerable weight, however. In 1883, at the Smithfield Club Show, at London, a four-year-old steer was exhibited that weighed 2,464 pounds, while a fat cow was credited with a weight of 2,214 pounds. These, of course, are very excessive figures. Fair representative weights are given as 1,500 to 1,800 pounds for the bull, and 1,300 to 1,400 pounds for the cow.

Black Welsh cattle are rated as very fair milkers by Welshmen. The cows average about 3,000 pounds of milk a year, while a better sort of individual produces 4,000 or more pounds. The quality of the milk is excellent. The Earl of Cawdor, a leading exhibitor of these cattle in the past, states that his cows produce twelve to fourteen quarts of milk daily, and that the quality, color and flavor of the butter from this milk is unsurpassed.

This breed, although unknown in America, is prominent in Wales and is well represented in some of the important English cattle shows, notably the Royal Agricultural Society Show. The breeders of North Wales established a herdbook association in 1883, and published the first volume of their records that year. The South Wales breeders also had a herdbook association. In 1904, these two societies amalgamated into the Welsh Cattle Society, and published their first herdbook in 1905.

Brahmin, Sacred Cattle or Zebus. Fig. 390.

These are a species of humped cattle, known as *Bos Indicus*. They are the so-called Sacred cattle of India. In works on natural history they are generally described as "Zebus." They were first introduced to the United States, perhaps, in 1853, by Mr. Davis, of South Carolina. Some other importation for agricultural purposes followed, notably in 1906. The Davis cattle were taken westward, their descendants becoming distributed in the Southwest and in Mexico. They are characterized by a light, silvery-gray color, with darker shadings of fore and hind parts; with hump over the shoulders, excessive dewlap and fulness of throttle, large drooping ear, and black, recurving horns. The disposition is not good.

Brahmin cattle were introduced to the southern states in the hope that they would better withstand the warm climate, insects and disease than would other cattle. In 1888, Prof. G. W. Curtis, of Texas, wrote of them to some extent in his work on "Horses, Cattle, Sheep and Swine," in which he stated that the pure-breds had played an important part in improving the native stock in southern Texas. The cross is said to improve the native beef, but cattle of this kind and their grades are not to be regarded seriously as factors in our live-stock industry. The cows yield a fair amount of milk, it is said, but it is very low in butter-fat. In India, these cattle are used for domestic purposes, especially as oxen.

Zebu cattle are being imported from time to time, but mainly for circuses or zoölogical gardens. They have been imported to South America, to cross with the native Caracu, in the hope of securing a hybrid that will be less subject to prevalent diseases.

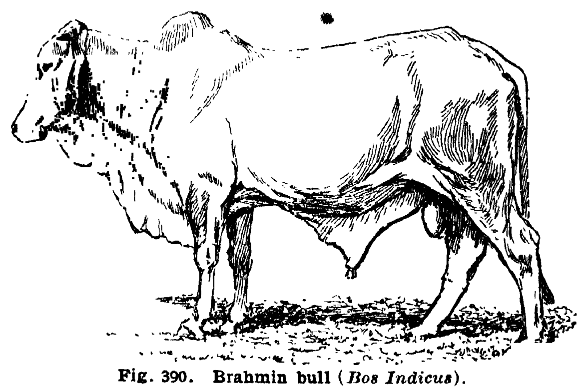

Fig. 390. Brahmin bull (*Bos Indicus*).

In regard to the importation of 1906, Dr. Mark Francis writes as follows: "In 1906, A. P. Borden, Pierce, Texas, went to India and brought sixty-four

head to America. They arrived at New York in the spring (1906) and were held in quarantine on an island off the coast of New Jersey all summer. The Bureau of Animal Industry destroyed about one-half of them for surra. The remainder were finally released, and arrived on the Pierce Ranch at Pierce, Texas, in November (1906). They were held here several months, when the lot was divided, and one-half of them taken to Victoria, Texas, and put on the ranch of Thomas O'Connor. There are seven distinct families, or strains of blood, represented. All are bulls but three. I tested seven of them to see whether they were immune to Texas fever. We got no reaction from inoculation, and decided that the whole lot were probably immune to Texas fever. Mr. Borden shows that those cattle that have some Brahma or Brahmin blood in them are in good flesh, while those carrying some Shorthorn or Hereford blood are in poor flesh, and must be fed in winter. His claims appear to me to be sustained. The Brahmin cattle seem to be able to stand the mosquitos, ticks, horn flies, liver-flukes and parasites generally much better than the so-called improved breeds. The bulls are of good size and bone, and not any of them are the small 'billy-goat' type seen in a certain menagerie. The oldest of Mr. O'Connor's bulls, a four-year-old, weighs about 2,000 pounds. This indicates the size that is attained."

BRETON OR BRITTANY CATTLE.

Breton or Brittany cattle are native to that section of Western France known as Brittany. They are one of the oldest breeds of Europe, and no doubt their blood was used in the early stock of what later became the Jersey and Guernsey.

The Breton cattle are black or black and white in color, although in one section red and white occurs. This is one of the smallest of the horned breed of cattle, having an average height of about thirty-six inches at the withers. It is a dairy breed, and, like the Kerry, the cows produce generously of milk in proportion to size. The average yield is about 1,700 pounds of milk a year, with well-fed individuals producing 2,500 pounds or more. When we bear in mind that cows of this breed weigh 350 to 450 pounds, and receive but scanty attention as a rule, this is a fair record. It is said that the Breton is very hardy, and that the cows live and do well where cattle of other breeds would starve. The Breton has been kept pure in some sections of Brittany, and in other localities the cows have been crossed with Shorthorn and Ayrshire bulls. The Shorthorn improved the size and fattening qualities, but unfavorably affected the milk secreting capacity. The Ayrshire cows did not give satisfactory returns either in beef or milk, while the docile temperament of the Breton was materially injured.

A few Breton cattle were brought to Massachusetts many years ago, and the writer became familiar with a pair of them in the herd of the Massachusetts Agricultural College. These were very small in size and mostly black in color. Unfortunately, they were disposed of before their merits became known.

HOLDERNESS CATTLE

In southern Yorkshire, England, lying north of the river Humber, is a rich, level district long ago known locally as Holderness. Here the cattle attained considerable size, were rather light of shoulder, large behind, had a considerable reputation as milkers, but were rather coarse in quality of flesh. These cattle, which were often more or less black in color, greatly resembled the Dutch cattle near by in Holland; in fact, it has been said that they originally came from Holland. Undoubtedly this early stock played its part in the development of the Shorthorn, and contributed toward establishing the value of the Shorthorn as a milk-producer. The cows were famous milkers and were especially popular with dairymen supplying London with milk. As late as the middle of the last century they had become much crossed with Shorthorn bulls, and the old-fashioned Holderness cow was rarely met with. In the present day this breed is of no special interest, excepting historically.

The American Holderness is a very little known American breed, said to have had its foundation in Holderness cows imported from the West Riding of Yorkshire about 1830. Just who was the first importer is not known. It is said that they were introduced into Massachusetts about that date. The man who is responsible for whatever progress the breed has made in America, is Truman A. Cole, of Solsville, N. Y. About 1855, he purchased from Mr. Knox, of Oneida county, N. Y., a single cow of this breed, which was said to have been from imported stock. She was a red and white cow, and was a superior milker. When purchased she was in calf, and in season dropped a bull. Later he was was bred to his dam, and from this foundation, by close inbreeding, has come this little-known American breed. In form, these cattle are said to resemble much the black and white cattle of Dutch breeding, with color which varies from red and white in calves to very dark brown or black at full maturity. They are deep-bodied, have large udders and teats, swollen and tortuous milk-veins, and yellow skin. The escutcheon is especially well developed. In 1879, Mr. Cole had in his herd nineteen cows that averaged 308 pounds of butter per cow. While the cows do not produce so heavy a yield as do the Holstein-Friesians, they give milk somewhat richer in butter-fat. The butter is excellent, of good keeping quality, and sold on the Utica (N. Y.) market at an advanced price. It is said that the cows fatten readily when dry and make a good quality of beef. A number of head from Mr. Cole's herd were sold to other breeders. [See pamphlet "Holderness Cattle," issued by Truman A. Cole (1887).]

KERRY AND DEXTER-KERRY CATTLE. Figs. 391–393.

Kerry cattle, embracing both beef and dairy types, have been bred by the people of Ireland as far back as history gives record, and are distinctly an Irish breed. Probably they are descended from the smaller type of the aboriginal cattle of Britain. They are found in largest numbers in the south-western part of Ireland in what are termed the

Kerry mountains. Herds are found, however, scattered all over the island.

There are two types of Kerry cattle, the true Kerry and the Dexter-Kerry. The true Kerry (Fig. 391) is distinctly a dairy breed, and is usually of a black color; red, however, may occur. White often prevails about the udder of the cow or the scrotum of the bull, but not elsewhere. The type is muscular, of the dairy form, with lean head, fairly thin neck, rather narrow withers, thin thighs and comparatively capacious udder. Good specimens show refinement, although, in their native homes, Kerries often show the effect of scanty food in retarded growth and rough appearance. The true Kerry cow at maturity usually weighs 500 to 600 pounds and the bulls 800 to 1,000 pounds. These figures vary according to care and food. As milk-producers, cows of this breed rank high, yielding an unusually large amount for their size. They have been known to give sixteen quarts a day when fresh, and the cow Red Rose produced nearly 10,000 pounds in one year.

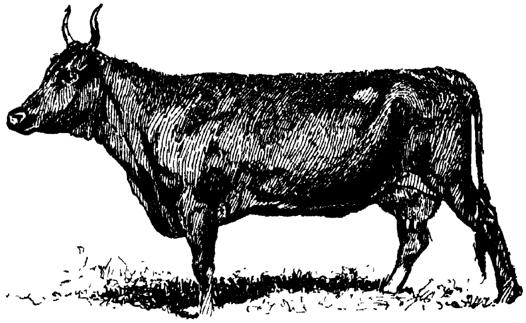

Fig. 391. Kerry cow.

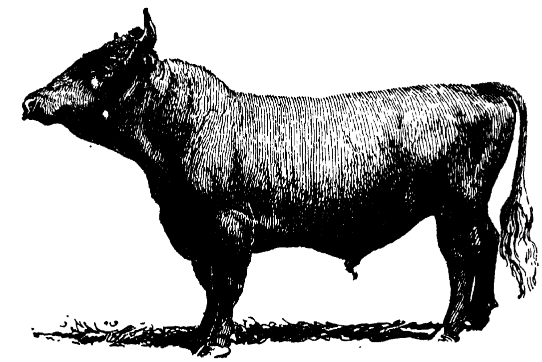

Fig. 392. Dexter-Kerry bull, La Mancha Union Jack. A great prize winner.

The Dexter-Kerry (Figs. 392, 393) is a beefy type of the Kerry family. It is of obscure ancestry, but it is supposed that a Mr. Dexter developed it by crossing the true Kerries on cattle of a beefy sort, possibly Shorthorns. This is really a diminutive, dual-purpose type. The composition is rather beefy, showing compactness, breadth of back, depth of rib, thickness of flesh generally, with excellent udder development. The legs are very short. Famous bulls of the breed have weighed about 500 pounds at maturity, and cows even less. Some well-known show Dexter-Kerries have stood about thirty-six inches high at maturity. The color is variable, and may be black, red or roan. The Dexter-Kerry is suited to beef-production on a small scale, and yields a very high grade of meat. The steers are found on the Irish market, and each year a small but select class are on exhibition at the Smithfield Club Show in London, where special prizes are offered for small cross-breds. In 1901, at a fat-stock exhibition at Birmingham, England, the first-prize Kerry steer weighed 840 pounds at eighteen months of age. This family of Kerries also produces considerable milk, although the milk-secreting habit is not so persistent as with the true Kerry.

Some choice herds of Kerries are to be found in England on the estates of men of wealth, who have taken up this little breed more as a fad than otherwise. A few specimens found their way to America many years ago, but the purity of breeding was soon destroyed. Twenty-five years ago there were a few pure-breds at the Massachusetts Agricultural College, but these were dispersed. At the present time, small herds are owned in New York and West Virginia, and another has recently been established in Illinois. Exportations of Kerries have been made from Ireland and England to Australia, South Africa and Canada. Undoubtedly the breed has much of merit and it deserves more attention. Its hardy character and capacity to produce milk on a large scale, in proportion to its size and cost of production, justifies its growth in public favor.

Longhorn Cattle.

Longhorn cattle represent a breed that was established in a definite manner by the breeding operations of Robert Bakewell, mainly in the latter half of the eighteenth century. Bakewell, largely by a process of selection, developed the cattle in the midland counties of England, notably Leicester, producing more rapid fattening, earlier maturity, and more economical killers than had previously existed. Longhorns became very famous and for many years were regarded as the best beef cattle of the country. Then the Shorthorn began to receive the attention of intelligent breeders, and the Longhorn gradually assumed an insignificant position among British breeds. Today, Longhorn cattle occur in very small numbers in Britain and their reputation is largely a matter of long ago.

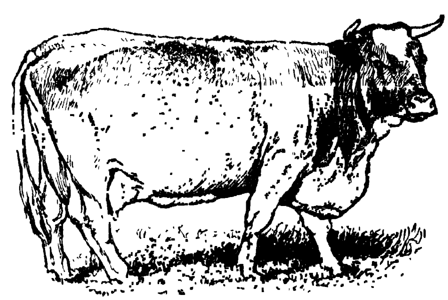

Fig. 393. Dexter-Kerry cow

This breed is of the large beef type, carrying considerable width of back, depth of rib, fulness of hind-quarter and thickness of flesh. Longhorns differ from other British breeds in the horn and color. The horn is very long, spreading, and often drooping. The writer has a photograph of a pair of these horns which measured eight feet around the curve, from tip to tip. The color of hair is commonly brindle, or brindle and white, or red and white, with white along the back and also with very light shading along the belly. The hair attains considerable length and the skin is thick and mellow. Coarseness has also attended the Longhorn. While not producing heavily of milk, the milk is regarded as rich in butter-fat.

The breed today is comparatively unknown in England, although efforts have been made to bring it back into popular favor. At recent shows of the Royal Agricultural Society of England, a few Longhorns have been exhibited and have attracted much attention, though mainly for their historic associations.

The Longhorn Cattle Society was organized some years ago, and in 1878 the first volume of a herd register was published, which recorded 286 bulls and a somewhat larger number of cows.

NORMANDY CATTLE.

Normandy cattle are natives of Normandy, in northwestern France. Strictly speaking, the common cattle of this section are known as the Contentin breed, there being various other races or breeds in France.

Some of the more important characteristics of this breed are as follows : Color variable, but usually either brindle, black or red ; head and neck rather heavy, the latter possessing more dewlap than with the British breeds ; body of large size, inclining to be flat of rib ; bone inclined to coarseness ; size large, developing heavy weight at maturity. The character of the meat is said to rank very high, although animals of the breed will not dress out a percentage of carcass to offal equal to the Shorthorn, Aberdeen-Angus or Hereford. As producers, the cows rank very high in France, yielding a large amount of milk rich in butter-fat. In the late seventies, Richardson wrote of dairies in LeBessin, near Isigny, that produced $5,000 worth of butter a year. Large amounts of butter and cheese are made in Normandy and extensive exports are made to other countries. Cotentin cattle have been crossed considerably with the Shorthorn, the two breeds nicking to great advantage.

A few cattle were brought to the United States from Normandy about 1895 by the late Theodore A. Havemeyer, and kept on his farm at Mahwah, N. J. They were imported for experimental purposes, to cross on Jerseys in the Havemeyer herd. The milk records of the pure-bred Normandy cows in this herd were quite comparable with those of so-called dairy Shorthorns. This herd was dispersed before the value of the cows became known.

A herdbook society, for promoting the breed, exists in France (Herdbook de la Race Normande Pure), with headquarters at Calvados.

SIMMENTHAL CATTLE. Fig. 16.

Simmenthal cattle, also called Bernese, and the Spotted Race, are native to the valley of the Simme in Switzerland. These and the Brown Swiss are the two important breeds of cattle in Switzerland. It is a very old breed and has long been looked on with favor in its native land. The cattle are better adapted to the Swiss valleys than to the mountain sides.

Not much of an attempt has been made to introduce this breed to America. About 1895, Mr. T. A. Havemeyer, of New York, imported some Simmenthal cattle with the purpose of crossing them with Jerseys. This he did and continued the work some years, but with his death the herd was dispersed in 1898, before any definite results were made public. One purpose of Mr. Havemeyer's experiments was to use the Simmenthal blood on the Jersey to improve the constitution, the former being a very hardy breed. So far as the writer is aware, this is the only serious attempt to introduce this breed to America. Without doubt the Simmenthal has merit, and it is singular that it should not have found its way to this country to a greater extent than it has.

This breed is what may be known as a dual-purpose sort, producing both beef and milk to a creditable extent. The tendency is somewhat to a blocky, thick conformation, covered well with flesh, while the cows in mature form carry large udders. The color is usually spotted, of drab or yellowish red and solid white markings. Sometimes the color is almost solid. Animals of the breed are large, and bulls attain a weight of 2,000 to 2,500 pounds, and cows often weigh over 1,500 pounds ; and larger weights are not uncommon. These cattle are also much used for oxen (Fig. 16), which may weigh 2,000 to 2,500 pounds.

As milk-producers, the cows have a fair reputation. A number of dairies in Switzerland, where records are kept, show milk-yields to range from 7,000 to 8,000 pounds a year. The milk is of a medium quality, twenty-five pounds yielding about a pound of butter. Ten pounds of milk are also usually counted to make a pound of cured cheese.

Some interesting milk records were secured with the pure-bred Simmenthalers in the Havemeyer herd. The cow, Pfan (79), from April 24, 1896 to February 27, 1897, produced 9,500 pounds of milk. Bari (411), as a four-year-old, from July, 1896 to September, 1897, produced 11,251 pounds of milk. Spiess (413), a five-year-old, from April 11, 1896 to April 22, 1897, produced 10,879 pounds of milk. These are better records than those published in Switzerland.

The Simmenthal as beef cattle rank high in Switzerland. They are expected to mature in about four years, and the beef is credited with being fine of grain and of superior flavor.

TEXAS LONGHORN CATTLE. Fig. 394.

There is no distinct breed of this name. What is familiarly known as the "Texas steer" is descended from the early Spanish cattle first introduced into Mexico, later becoming distributed over the southwestern range. The color was variable, dun, yel-

low, black, and red prevailing, often with striking white markings. These were narrow-backed, flat-ribbed, leggy cattle, with heavy head and frequently widely spreading horns. They were slow and hard feeders, and did not attain large size, the bulls rarely weighing over 1,200 pounds and the cows ranging from 600 to 900 pounds. With the development of the western range in the seventies, began

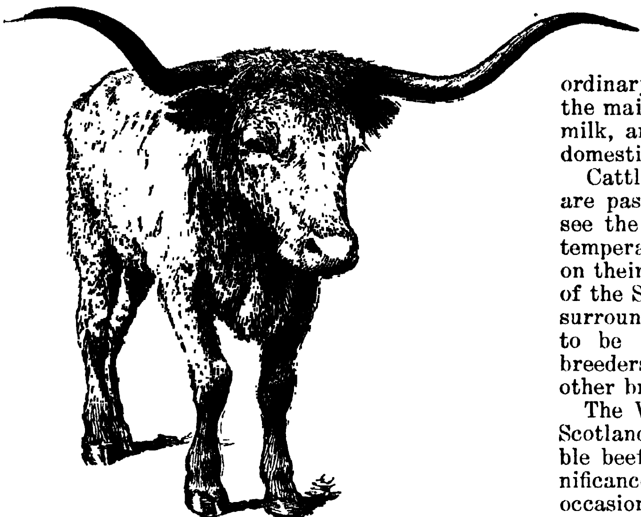

Fig. 394. Texas Longhorn.

the introduction on a considerable scale of pure-bred Hereford and Shorthorn bulls. Since this time, the old Longhorn has been about bred out, and today Texas and the Southwest have cattle really much superior in breeding to most of the other sections of the country.

West Highland Cattle.

West Highland cattle represent a distinctly Scotch breed. From time immemorial the West Highland, or Kyloe as it was formerly known, has been bred among the mountains of western Scotland. It is generally thought that this breed is of aboriginal descent. Over a century ago, Culley included the Highland as one of the very few breeds treated by him in his book on live-stock. Undoubtedly, West Highland cattle have been bred for centuries in the west highlands, especially in Argyll, Perth and Inverness counties and on the Hebrides islands.

The West Highland is distinctly of the beef type, being blocky, broad of back, deep-ribbed, thick-fleshed and short of leg. The long, wide-spreading horn, and long, shaggy mane and coat of hair are peculiar to this breed and give it much individuality. The hair in winter has extreme length and thickness, and gives admirable protection from rain and cold. The color is variable, and black, brown, red and brindle are seen in the same herd. A rich yellowish red or tawny color is a favorite with some breeders. Broken colors are not popular and are uncommon.

West Highland cattle do not usually attain large size. They are slow to mature, and the cows weigh about 900 pounds and the bulls 1,200. One may see much larger specimens at the Scotch shows, but, under ordinary field conditions, they do not weigh heavy. The quality of beef produced by the breed is very superior. Nothing excels it in the British market. The flavor is choice and the grain fine and of the best quality. In the London market a well-fleshed West Highland steer brings the highest price.

As milk-producers the cows are very ordinary. This might naturally be expected, as the main object is simply to furnish the calves with milk, and not, to any extent, to furnish milk for domestic purposes.

Cattle of this breed are very hardy. Their lives are passed on the hills, and, as a rule, they never see the interior of a barn, even in midwinter. In temperament they are wild and high spirited when on their native hills, and never assume the docility of the Shorthorn or Jersey under the most domestic surroundings. Their reproductive qualities are said to be good, and the cows continue as active breeders for more years than is usual with most other breeds.

The West Highland breed is chiefly valued in Scotland for its easy-keeping character and valuable beef. It has never secured a foothold of significance away from its native hills. One may occasionally see herds on estates in England, but these are steers brought from the Highlands for fattening, and are kept in part for their picturesque effect. A few specimens of the breed have been brought to America, but they have been regarded mainly as curiosities. Some attempt has been made to introduce them on the western range, notably in Kansas and the far Northwest, but nothing has yet come from the movement. While their hardiness and superior quality of beef commend them, they are so inferior to the Hereford, Shorthorn or other beef cattle on the range, in rapid maturity and weight, that they are not likely ever to receive serious consideration from the pure-bred point of view. The cross-bred West Highland may be an improvement on the pure stock, but even then the value of the herd in America is open to serious question. No doubt in the grazing districts of the higher mountains of the Atlantic coast states the breed might prosper and be of value. West Highland cows may be crossed with other British beef breeds to advantage, but this will be breeding away from the blood of the mountain breed rather than toward it. Galloway and Aberdeen-Angus bulls are especially commended for this purpose. The use of the West Highland bull on native cows might contribute to constitutional vigor, but it is more than likely that more will be lost than gained by such a cross.

Literature.

American writings contain very meager accounts of these lesser-known breeds of cattle. For general references, the reader is referred to page 302.

DOGS, FARM. *Canis familiaris*, Linn. *Canidæ*. Figs. 395–399.

The dog belongs to the order Carnivores, the family Canidæ, and the genus Canis. The origin of the domestic dog is not known. It is supposed that it is the result of many crosses with many different types, under various conditions, as the owner wandered from place to place. It is probable that the jackal and the wolf have been important elements in the evolution of the domestic dog.

The dog has long occupied a prominent place on the farm, especially as a watch-dog and a sheep-dog. Much of the police duty on the stock-farm is entrusted to the dog. He looks out for the vermin and small game that would become troublesome; he is an indispensable aid in hunting; and as a companion he is a privileged member of the household.

The adaptability of certain breeds of dogs for farm purposes is generally known. The care and intelligence displayed by a well-trained dog in handling stock is well-nigh remarkable. The two recognized breeds for herding and driving purposes are the Collie and the Old English Bobtail Sheep-dog. Individuals of many other breeds are trained for this work with some success, and a great variety of dogs, good, bad and indifferent, are found on the farm.

The Collie Dog. Fig. 395. See also page 595.

By *Herbert W. Mumford.*

The Collie is one of the most useful breeds of farm dogs. His origin is not known. Probably, however, he has been developed from the Old English Sheep-dog by crossing with the Scotch Greyhound. The rough-coated Scotch Collie is the best known and most highly prized variety in this country. The smooth-coated type is well known in Great Britain and is preferred by some persons.

Dog shows and public sheep-driving trials have had a tendency to popularize the Collie. They have had a wholesome effect in setting standards and bringing about greater uniformity in type among so-called high-class Collies. There was a noticeable lack of uniformity among them previous to the establishment of these exhibitions. It should not be inferred that all Collies are invariably good and that one is sure to get a good dog if only he buys a pedigreed Collie. It means simply that there is a well-defined ideal type which progressive breeders are striving to produce. As in other breeds of domesticated animals, fashion in blood lines, in coloring, and in markings, has to be reckoned with in determining the value of a Collie.

Description.

In general, the Collie is light and graceful, showing a combination of agility, speed and suppleness, with a power of endurance that few other breeds possess. High intelligence, good appearance and devotion characterize this breed. The following is a description of a rough-coated Collie as revised by the Collie Club in 1898:

The *skull* should be flat, moderately wide between the ears, and gradually tapering to the eyes. There should be only a slight depression at "stop." The width of the skull necessarily depends on the combined length of skull and muzzle, and the whole must be considered in connection with the size of the dog. The cheek should not be full or prominent. The *muzzle* should be of fair length, tapering to nose, and must not show weakness, or be snipy or lippy. Whatever the color of the dog may be, the nose must be black. The *teeth* should be of good size, sound, and level; very slight uneveness is permissible. The *jaws* should be clean-cut and powerful. The *eyes* are a very important feature, and give expression to the dog. They should be of medium size, set somewhat obliquely, of almond shape, and of brown color except in the case of

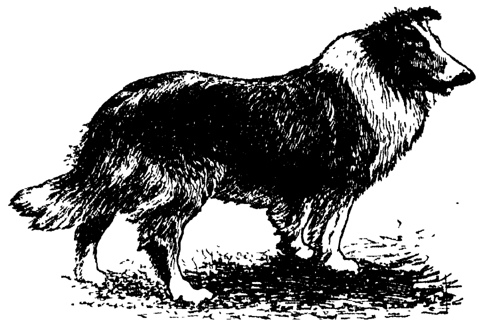

Fig. 395. An imported rough-coated Scotch Collie. Owned by J. I. Behling, Milwaukee.

marles, when the eyes are frequently (one or both) blue and white or china; the expression should be full of intelligence, with a quick, alert look when listening. The *ears* should be small and moderately wide at base, and placed not too close together on top of skull, nor too much to side of the head. When in repose they should be usually carried back, but when on the alert, brought forward and carried semi-erect, with tip slightly drooping in an attitude of listening. The *neck* should be muscular, powerful, and of fair length, and somewhat arched. The *body* should be rather long, with well-sprung ribs, chest deep, fairly broad behind the shoulders, which should be sloping; loins should be slightly arched and powerful. The dog should be straight in front. The *fore-legs* should be straight and muscular, neither in nor out at elbows, with a fair amount of bone; the fore-arm should be somewhat fleshy, the pasterns showing flexibility without weakness. The *hind-legs* should be muscular at the thighs, clean and sinewy below the hocks, with well-bent stifles. The *feet* should be oval in shape, the soles well padded, and the toes well arched and close together. The hind-feet should be less arched, with hocks well let down and powerful. The *brush* should be moderately long, carried low when the dog is quiet, with a slight upward "swirl" at the end, and may be gaily carried when the dog is excited, but not over the back. The *coat* should be very dense, the outer coat harsh to the touch, the inner coat soft, furry, and very close, so close as almost to hide the skin. The mane and frill

should be very abundant, the mask or face smooth, as also the ears at the tips, but they should carry more hair toward the base; the fore-legs should be well feathered, the hind-legs above the hocks profusely so, but below the hocks fairly smooth, although all heavily coated Collies are likely to grow a slight feathering. The hair on the brush should be very profuse. The *color* is immaterial. In *general character* the Collie should be a lithe, active dog, his deep chest showing lung power; his neck, strength; his sloping shoulders and well-bent hocks indicating speed; and his expression, high intelligence. He should be a fair length on the leg, giving him more of a racy than a cloddy appearance. In a few words, a Collie should show endurance, activity, and intelligence, with free and true action. In *size*, the dogs should be twenty-two inches to twenty-four inches at the shoulders; the bitches, twenty inches to twenty-two inches. In *weight*, the dogs should register forty-five to sixty-five pounds; the bitches, forty to fifty-five pounds. The smooth Collie differs from the rough only in its coat, which should be hard, dense, and smooth.

Faults.—The following are considered faults: Domed skull, high-peaked occipital bone, heavy, pendulous, or prick ears, weak jaws, snipy muzzle, full staring or light eyes, crooked legs, flat or hare feet, curly or soft coat, cow hocks, brush twisted or carried right over the back, and an under- or an over-shot mouth.

SCALE OF POINTS FOR COLLIE DOG	Perfect score
1. Head	25
2. Ears	15
3. Body	15
4. Legs and feet	15
5. Coat	25
6. Tail	5
Perfection	100

In the matter of color there is much variation. There are the so-called sables, the sable and whites, the black and whites, the whites and the tricolors, black, tan and white. The most desirable white markings on either the tricolors or the sable and whites are a white stripe in the face, a full white collar, white breast, white feet and white tip to the tail. There are but relatively few Collies that possess these perfect markings and some of them that do are deficient in more important points. Color should be the last consideration in buying a Collie dog.

Distribution.

From his native home in Scotland, the Collie has gone out into all parts of the civilized world; and wherever he has arrived he has made innumerable friends. His rare beauty and intelligence, together with the enterprise of Collie breeders, won and has held for him a leading place among those who have a fondness for dogs.

The Collie has become such a prime favorite that his popularity in the city, as well as in the country, is second to no other breed. Dog fanciers nearly everywhere have taken up the breeding of Collies as a fad. The breeding of Collies in Great Britain is attended with greater success than in this country, whether the measure of success be the number of high-class individuals produced or the net profit secured in the enterprise.

Famous Collie dogs.

A few of the famous Collie dogs in this country are: Wishaw Clinker, Winnetka Christopher, Wellesbourne Conqueror, Ormskirk Olympian, Parbold Paragon and Ellwyn Perfection. Most of these dogs are rich in blood of one or more of the following dogs that have been looked on as pillars in the Collie studbook: Stracathro Ralph, Christopher, Metchley Wonder, Edgbaston Marvel and Great Alne Douglas. One of the most celebrated Collies of history is Southport Perfection. This dog sold at one time for $6,000. Christopher, a scarcely less celebrated dog, sold for $5,000. Metchley Wonder and Edgbaston Marvel each sold for $2,500.

Care and feeding.

Every dog, whether on the farm or elsewhere, should have an individual kennel which he may look on as his home, and where in case of sickness he may be isolated and given proper care. The location of the kennel should be carefully chosen. Abundant sunlight and good drainage are prime requisites in preserving the health of a dog. If it is desired to have a yard in which the dog can be confined, this should be dry and well drained, and preferably have a concrete floor, as dirt yards about kennels soon become foul and thus invite disease. A southern exposure is best. In hot weather, ample provision for shade should be made, but it is not desirable to have the yard entirely or even largely shaded, as the sun should have access, as far as practicable, at some time during the day, to every part of the enclosure.

Straw makes very satisfactory bedding for the kennel, the sleeping bench of which it is best to have raised about ten inches from the floor. Kennels should be cleaned frequently and thoroughly, and the bedding changed every week. When the kennels are being cleaned, they should be carefully disinfected. An occasional liming or whitewashing is excellent.

As a rule, mature dogs are fed too often. Twice daily is ample,—a light breakfast and a hearty evening meal. There is a great difference in the food requirements of different dogs, some being light eaters while others consume large quantities. This difference is due largely to their temperament and degree of activity. The judgment of the one who feeds the dog must be depended on properly to regulate the quantity of food required. The general appearance of the dog's coat and his behavior when fed are fairly good guides. Meat should not comprise any large part of the ration of the dog. Most authorities on the feeding of dogs agree that they should not be fed warm food. All cooked foods should be allowed to cool before being fed. Dogs should be encouraged in every way to eat dry biscuits. Cooked vegetables should be fed at least

twice a week, although care should be taken not to feed too much soft food. Regularity in feeding dogs produces the same beneficial effects that it does in the feeding of other kinds of domestic animals. As a rule, the feeding of the dog is given very little thought. Feasts and fasts are the order, and such treatment is likely to cause serious digestive disturbances.

Cost.

If one insists on buying a high-class Collie, that possesses to a great degree all of the fancy points of the breed, including color and markings, he must be prepared to pay a high price, as has been shown in the preceding paragraph. Such Collies are rare, and the experienced breeder feels well satisfied if he is able to secure a high-class one from each litter. Pedigreed Collies of indifferent breeding and individuality may be purchased at very low prices, but Collies of choice breeding and individuality are worth from twenty dollars up. Well-bred puppies that are not desirable, from the fancier's point of view, because of some lack in individuality, are disposed of by the breeders at ten to twenty dollars. The breeding of Collies good enough to win at leading shows is an extremely difficult business. The breeding of Collies that are much more handsome and more useful than the average dog, is relatively easy.

Uses.

While originally developed as a sheep-dog to aid the shepherd in guarding, herding and driving sheep, and still holding a foremost place for this purpose, the Collie has become a universal favorite as a companion for children and grown-ups and as a watch-dog.

There are those who think that the smooth-coated Collie is a better worker than the rough-coated type. Again, there are those who are prejudiced in favor of the tricolor, or black and white and tan, as a worker. The sable and the sable and white, however, are most popular among the fanciers and will usually sell more readily and at higher prices than the tricolors.

Because the Collie is such a favorite at dog-shows and has been so persistently bred for the bench, it is said that the modern bench type has lost much of its former intelligence and instinct for driving. It must be admitted that but very few of our most valuable Collies have ever been trained to drive live-stock, and the majority of them, until trained, would be useless for agricultural purposes. It is even doubted whether some of them are susceptible of a high degree of training. This latter is true not only of show Collies but of others as well. There is no good reason why a good show Collie should not make, with proper training, a good driver. Well-trained dogs, however, are seldom in proper condition for show. The rugged life to which many of them are subjected unfits them for exhibition purposes. In this way, the show may militate against the best development of the Collie for farm purposes.

It is doubtful whether the Collie has really lost in intelligence. He has certainly lost much in opportunity, but what he has lost in opportunity he has gained in beauty and elegance; and while formerly only the sheep-herder was familiar with his excellent qualities and privileged with his companionship, he is today admitted to the most exclusive society.

Ailments.

The ailments of dogs that are most troublesome and likely to be met with are distemper, worms and fleas.

Distemper.—Of all the diseases of dogs, distemper is by far the most to be feared. It assumes a great variety of forms and is not so well understood as other diseases (see page 142). The writer takes the liberty of quoting from "The Collie" [see *Literature*] the discussion of the disease as it appears in that work: "It is a contagious febrile disease, and therefore, once it has been diagnosed, the subject should be isolated, and the same person should not be allowed to wait on the affected dog and the healthy ones, as the contagion is readily conveyed. In order to prevent distemper, all that the thoughtful owner can do is to keep his young stock in robust health; then, if any, or all, should fall victims, they will be less liable to "go under" than the weakling and the wastrel.

"Usually the disease is ushered in with catarrh, accompanied by a poor appetite, lassitude, hot nose, furred tongue, eye inflammation, and a discharge alike from eyes and nose—thin at first, but becoming thicker as the disease progresses. Usually, too, the bowels are loose, while the under part of the belly not infrequently becomes spotted. Good nursing will do more good than drugs, providing it be in conjunction with warmth and well-ventilated quarters. An even temperature is desirable, and the patient should wear a flannel coat. The eyes and nose should be sponged clean of discharge, using a little rose-pink solution of Condy's Fluid (warm). There is almost certain to be a cough; but so long as the lungs and bronchi are not involved, this will soon cease to trouble. When, however, pneumonia supervenes, the aid of the veterinary surgeon should be at once invoked, as also when that form of distemper accompanied by jaundice is present. This latter is shown by the yellowness of the mucous membranes—a condition that has given rise to the name of the "yellows." Diarrhea, if present, should be relieved by means of carbonate of bismuth, given dry on the tongue twice a day—the dose varying from 10 grains to 30 or 40 grains. If there be a high temperature (over 103°), something must be done to reduce it. Dissolve 2 drams of salacin in a little hot water, add ½ ounce of tincture of gentian and sufficient water to make 6 ounces, and give a dessertspoonful three times a day.

"The food during the time the patient is unwell should be light and nourishing. It may consist of good broth poured over stale brown bread. The best is made from sheep's head boiled. The meat may also be cut up and added to the mass. Beaten-up egg and Bovril are also useful when more solid

food is refused. The patient should be fed on the 'little and often' principle."

Worms.—Tapeworms, threadworms and roundworms are commonly met with. The roundworm is the form which most prevails in puppies, while the tapeworm is frequently found in adult dogs. The presence of worms is usually indicated by a staring coat, a cough, irregular bowels, and, in some instances, severe diarrhea, and sickness. In some cases worms are vomited. Various worm remedies for dogs are on sale at drug-stores, and many of these remedies are as satisfactory as any prescribed remedies with which the writer is familiar. Vermifuges, of whatever nature, should always be administered to a dog after a period of fasting.

Fleas.—Fleas greatly annoy dogs, and the long coat of a rough-coated Collie makes a good refuge for them. There are numerous insecticides on the market that are good. Care should be taken when attempting to eradicate fleas or lice, thoroughly to clean the kennel and follow the cleaning with a free use of some good insecticide.

Organizations and records.

The Collie Club of England was founded in 1881. This club aided greatly in promoting the interests of the breed both at home and abroad. An American Collie Club has also been organized. A Collie studbook is issued. There are a few local Collie clubs scattered over the country.

The Old English Bobtail Sheep-dog. Fig. 396.

By *Frederick Freeman Lloyd.*

The name of this useful, sagacious and quaint-appearing dog exactly explains his ancestry and occupation, although, strictly speaking, the Bobtail Sheep-dog is as much a cattle-dog as a sheep-dog. There are varieties of these rough- and heavy-coated Sheep-dogs in other European and Asiatic countries than England, which, however, have long tails. It is one of the oldest breeds of dogs.

Description.

In general appearance, the Bobtail is a strong compact-looking dog of great symmetry, absolutely free from legginess or weaselness, profusely coated all over, very elastic in his gallop, but in walking or trotting he has a characteristic ambling or pacing movement. His bark should be loud, with plenty of "ring" in it. He is a thick-set, muscular, able-bodied dog, with a most intelligent expression, free from all poodle and deerhound character. While a fast-enough dog for the wildest of sheep, he is not hard on them; and his great sense or sagacity makes him more of a human companion than simply a dog-aid.

While breeders of Collies and some others of their kind breed for long-headed dogs, the producers of Bobtails strive, and rightly, after good, capacious skulls, and those well-developed frontal bones that go to make up, what is generally considered the "brain-box," that structure that contains the common sense always required in a dog whose every-day occupation is tending herds and flocks.

A great characteristic of the Bobtail is his ruggedness. Because of the density of his coat he can put up with the most severe climates. The best Bobtails have very heavy coats, there being an undercoat on the body with a long, harsh and almost wire-like overcoat of the texture of the mane of a horse. The undercoat keeps the dog warm and his skin protected from wet and rain, while mois-

Fig. 396. Old English Sheep-dog. Owned by Mrs. Mitchell Harrison, Chestnut Hill, Pa.

ture will roll off the outer coat. Great points in the breed are the all-round feathered fore-legs, and the general massiveness and squareness of the hind-quarters.

Bobtails may be of any color, but the most valued and beautiful are the pigeon-blue and white, and the dark steel-blue and white, the white being found about the muzzle, head, collar, neck, fore-legs and sometimes from the hocks to the feet of the hind-legs. These hocks should be well let down, while the fore-legs must be straight, and the body well loined, comparatively short, and strongly ribbed and rounded. The darker blue puppies are born black; with a little age, white hairs come through the black, which become lighter, the whole making a blue grizzle. Some dogs are entirely whole or self-colored. While these are not less useful, the marked ones are preferred, for they are more striking in appearance, and, as workers, can be seen at a greater distance, especially in dismal and indifferent weather.

The colors of the eyes of a Bobtail vary according to the body or color of the dog. In the blues, the eyes are bluish and grayish. With white dogs we will very often find a "wall," "china" or "marble" eye. This is highly typical. It is said that a dog with a wall eye never fails in the sight of that organ.

It is more than probable that dogs of this breed, in the ages that are past, were bigger, for they had, generally, to protect their flocks from the larger carnivoræ, which Britain does not now possess. Within the last two decades Bobtails have become larger. Soft coats have, unfortunately, been somewhat noticeable, but the majority of specimens we see at the present-day shows are magnificent creatures. The present-day dogs are in type,

make and shape, coat, stature and general characteristics a great deal better than the first of this breed to arrive on this continent. A dog standing twenty five inches, fair measurement, at the shoulder may be considered tall enough; a bitch two inches less would be considered equally well grown.

The following is the official description of the Old English Sheep-dog: The *skull* should be capacious and rather squarely formed, giving plenty of room for brain-power. The parts over the eyes should be well arched and the whole well covered with hair. The *jaw* should be fairly long, strong, square and truncated; the stop should be defined to avoid a deerhound face (the attention of judges is particularly called to the above properties, as a long narrow head is a deformity). The *eyes* vary according to the color of the dog, but in the glaucous or blue dogs a pearl, wall, or china eye is considered typical. The *nose* is always black, large or capacious. The *teeth* are strong and large, evenly placed and level in opposition. The *ears* are small and carried flat to side of head, and coated moderately. The *fore-legs* should be dead straight, with plenty of bone, removing the body a medium height from the ground, without approaching legginess; they should be well coated all around. The *feet* should be small and round, the toes well arched and the pads thick and hard. *Tail:* Puppies requiring docking must have an appendage left of one and one-half to two inches, and the operation must be performed when the puppy is not older than four days. The *neck* should be fairly long, arched gracefully, and well coated with hair. The *shoulders* should be sloping and narrow at the point, the dog standing lower at the shoulder than at the loin. The *body* should be rather short and very compact; the ribs well sprung, and the brisket deep and capacious. The loin should be very stout and gently arched, while the hind-quarters should be round and muscular, with well let-down hocks, and the hams densely coated with the thick long jacket, in excess of any other part. The *coat* should be profuse and of a good hard texture; not straight, but shaggy and free from curl. The undercoat should be a waterproof pile, when not removed by grooming or season. As to *color*, any shade of gray, grizzle, blue, or blue merled, with or without white markings, or in reverse, is allowable. In *height*, twenty-two inches and upwards for dogs, and slightly less for bitches is required.

Scale of Points for Old English Sheep-dog

	Perfect score
1. Head	5
2. Eye	5
3. Color	10
4. Ears	5
5. Body, loins and hind-quarters	20
6. Jaw	10
7. Nose	5
8. Teeth	5
9. Legs	10
10. Neck and shoulders	10
11. Coat	15
Perfection	100

History.

Seventy-five to one hundred years ago, tailless dogs were exempt from tax in England. It was supposed that he would be a man of little pride who would own a tailless dog in those days, a sure sign that he was too poor or too mean to pay for his canine farm help. Still, there were other reasons. The game laws of the native country of the Bobtail have always been very strict, and to kill a hare was looked on, until a few years ago, as almost a crime on the part of a tenant farmer. The tail is a natural help to a dog in turning quickly, as the hare turns when coursed and overtaken. Without his tail, the dog is sadly at fault in the wrench and turn, and he loses much ground. For this reason, the cut or bobbed sheep-dogs were not looked on as dangerous to game, and their owners were given tax exemptions for them accordingly.

From this breed of short-tailed dogs arose the splendid animals kept today for bench shows, sheep-dog trials, sheep-herding, general farm work, and companions. They are among the most valuable of all breeds, and the importations and breeding operations in the United States and some parts of Canada are extensive.

The Old English Sheep-dog was the old-fashioned sheep-dog of the English farmer of generations ago. But with the advent of Scotch Collies from the North, which mostly accompanied their masters engaged as stewards or managers,—for Scotchmen have always been noted agriculturists and pastoralists,—these dogs became somewhat generally and widely distributed. Still, the Bobtails remained in the hands of drovers; and among dealers and farmers attending markets and fairs, they have always been held as of the utmost value. Their ability to drive strange cattle and sheep through crowded and difficult thoroughfares is remarkable.

In America.—Perhaps the first dog of this breed, of any note, to be imported was Sir Lucifer, which was purchased in the middle "eighties" by the Glencoe Kennels, East Bethlehem, Washington county, Pennsylvania, who also owned Bob and Dame Hester. About 1888, Mr. William Wade, then of Hulton, Pennnsylvania, took more than a passing interest in the breed and helped to develop it in this country. These imported Bobtails weighed from sixty pounds, with the bitches of less weight, downward to forty-five pounds. Today the males and females are much larger, and are far more valuable. Twenty years ago in England (the dog market of the world), good show specimens were worth $250; now $500 to $1,000 is no uncommon price; and at such figures some of the present-day dogs have reached these shores. While there were but three or four individuals in 1886, no fewer than thirty-three first-class specimens were registered at the American Kennel Club, New York, 1906.

Never were there more and better Old English Bobtail Sheep-dogs than at the present time. The breed is strongly supported, not only by agriculturists who value them for their work and good looks, but other persons of position in both hemi-

spheres, who recognize in this Sheep-dog the representative of the old shepherd breed, and a peculiarly sagacious and handsome animal.

Distribution.

The Old English Sheep-dog is now widely distributed in those countries where dog shows are held. The home of the breed, and of kinds closely related to him, is in northern Europe. The best Bobtail living at the present day is Handsome Boy, owned by Mrs. Tyler Morse, of New York and Boston. Handsome Boy is a magnificent specimen, carrying an enormous coat. He is blind in one eye, but so truly representative is he, that judges are inclined to overlook that blemish.

Feeding.

The general scraps of the farmhouse make a good and substantial meal for the Sheep-dog. Cracked corn, well boiled with vegetables and fat or lean flesh, is eaten with avidity. With always access to grass the dog will keep himself in the best of health, the herbage being an excellent vermifuge.

Removing the tail.

Even in the best and most carefully bred litters of Bobtails, whelps are to be found with tails of different lengths, while some are tailless. All the tails should be immediately removed close to the rump with a pair of sharp scissors or nippers. A little balsam may be placed on the small sore, or it can be left to the good attention of the mother, who will lick and clean it while it is healing. The earlier the tail-cutting is accomplished, the more forward will the puppy become, while the pain is next to nothing.

Organizations and records.

The Old English Sheep-dog Club of England was founded in 1888, with the present writer as its first secretary. He drew up a description and scale of points of the breed on which lines the breed was, and is, generally judged. There is an Old English Sheep-dog Club of America, organized in 1903. At all times the addresses of the secretaries of these clubs, formed to promote the interests of the breed under notice, may be had by inquiry at the American Kennel Club, New York City, and the English Kennel Club, London, England. The studbooks, wherein these dogs are mentioned and the pedigrees of many of the best types are given, are published by the English and American Kennel Clubs.

Literature.

There is little literature that is related particularly to farm dogs, although much has been written on dogs in general. The latest illustrated description of Old English Sheep-dogs is given by Lloyd, in "Dogs," The Library Supply Company of America, New York City (1907). The reader may also consult Lloyd, The World's Sheep and Cattle Dogs, Dog-Lover's Publishing Co., Lansdowne, Pa.; Rawdon Lee, Field, London; Hugh Dalziel, The Collie, L. Upcot Gill, London; Lee, Collie or Sheep-Dog; Wickham, Practical Training of the Shepherd Dog.

Sheep-dog Trials. Figs. 397–399.

By *Frederick Freeman Lloyd.*

The first public sheep-dog trials ever held were at Bala, North Wales, Great Britain, in 1873. Since then they have become very popular and are almost a national pastime in Wales, England, Australia and New Zealand. There are also competitions of this kind in Scotland, in the eastern states of the Union, and in Canada, the trials at the annual international fair at Toronto being unquestionably the best held on the American continent. The first trials to be held in the United States were at Philadelphia, in 1880, and at Pittsburg, in 1881. The latter were under the patronage of the Pennsylvania State Agricultural Society. These trials prove great attractions at fairs and are on the increase in this country, being supported by the Collie Club of America and other institutions or associations. Their value and charm lie in the fact that they demonstrate the true utility of the dog.

Trials in Australia, England and France.

In Australia, a small, prick-eared and generally black dog with a smooth or flat coat is used. He is called "the Barb," after a celebrated dog of that name. Sheep-dog trials last for days in connection with the annual show of the Sheep Breeders' Association, at Sydney, N. S. W., a very important society, which interests itself in the flocks and sheep-dogs of possibly the greatest sheep-raising country in the world. Valuable prizes are offered at nearly all Australian shows; and, as almost every township and village has its annual gathering devoted to matters agricultural and pastoral, it can well be gathered that sheep-dog trials are of great account and held in the highest esteem.

In England, prominent land-owners, such as Lord Rothschild, give large sums for prizes for sheep-dog trials. The competitions at Tring Park each autumn are watched by a vast concourse of town and country people, who are kept in breathless excitement by the interesting work of the dogs. Welsh, Scotch or Herdwick sheep should always be used for trials; the Down sheep are considered too slow and too fat.

In France, a number of sheep—say a score—are used, the dog being required to fetch, drive and house them in a railway truck at a station. The trials are held under the patronage of the Department of Agriculture.

The dogs.

All breeds of sheep-dogs are used for this work, the show points of the animal counting for nothing, except in the case of special prizes given for dogs of any particular breed when merit is considered, so far as the bench or ring sheep-dog is concerned. Some extra well-bred Collies have been known to be very good workers in these contests, but the majority of the dogs used are those that are daily at work on farms, ranches or stations—the latter the great Antipodean sheep-runs, where dogs are of the utmost value.

The requirements of the dog are obvious. He should be silent at his work and never, under any circumstances, bite or mouth his sheep. He must be taught to work in the direction of the swing of the hand and drop to whistle or voice, or go on as desired. The merit of a dog is estimated by the time he takes to pen his charges without materially forcing them. Naturally, now and then, a dog is favored with "luck," but the best animal is nearly always to be found the winner of the stake. Three money prizes are generally given, with extra honorariums for the shepherd or handler.

All dogs, except the working one, must be held on a leash during a trial; in the event of a dog getting loose, the owner of it should be promptly fined, or the dog disqualified from competition, at the option of the stewards. The fine must be mentioned in the rules governing the meeting.

There is no studbook for dogs that have competed or won at sheep-dog trials. Pedigrees may be given on the entry form, but the age (if known) must be mentioned at the time of making

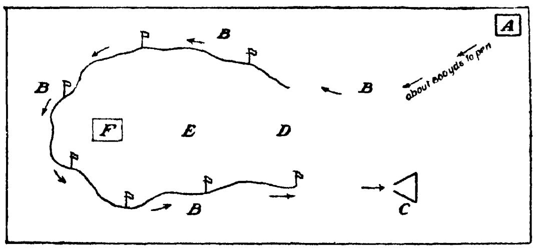

Fig. 397. Simple course for sheep-dog trial. A, Sheep; B, course, outside of flags; C, pen, made of three ordinary hurdles, with sufficient room at opening to allow entrance of only one sheep at a time; D, shepherd's first position on sending dog to find sheep, say 800 yards away; E, first position of judges; F, public Time allowed, say fifteen minutes.

the entry. The fuller the particulars the more widespread becomes the fame of the dog's works. A dog should be reckoned a puppy until he is twelve months old on the first day of the competition in which he is entered. Dogs and bitches are considered of the same account, but in no case may a proud or in-season female be worked at public trials.

The sheep.

The handler or shepherd must not touch the sheep with his hands, and should remain in close proximity to the home hurdles and pen until the driven sheep arrive in that neighborhood. Strange (to the dog) sheep are always used, a trio from flocks before unassociated being the charges. Strange wild sheep are wilder than ever; they will not pack but will "split" and run in all directions, giving the dog the maximum of work and trying his temper to the utmost. A ewe, a wether and a big lamb—all strangers—make a difficult trio. Sheep from the same flock are more easy to handle, and it is advisable to provide such for early trials when the dogs have not yet reached the perfection of "professional" trial dogs and worked by very experienced public handlers. It may be mentioned here that Australians have been heard to back themselves and dog to drive a hen into a small flower-pot placed lengthwise in the open field in a given number of minutes. The progeny of domestic dogs crossed with wild dogs cannot be

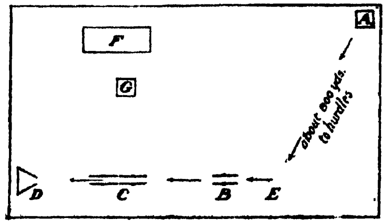

Fig. 398. Course for medium-trained dogs. A, Sheep; B, first pair of single hurdles with room between for only one sheep to pass; C, two sets of hurdles joined, placed twenty-five yards from B, and allowing same room as B; D, pen made of three hurdles, twenty yards from C, with room for entry of one sheep at a time: E, shepherd; F, public; G, judges. Time allowed, say fifteen minutes.

depended on for generations as honest and nonworrying sheep-dogs.

The course. Figs. 397-399.

Of the plans given, the one represented in Fig. 398 is recommended for medium-trained dogs. The one suggested in Fig. 399 is very complex, and is suitable only for dogs of considerable experience. It is difficult because of the maltese cross, which is hard to negotiate. It is suitable for a show-ring enclosure, the judges acting from a stand. The arrows indicate the course over which the sheep are to be driven. A study of these plans will best indicate the nature of the trials. The sheep are turned out of the yard at some distance from the course. The yard may be in sight or hidden, as arranged. From his first position, the shepherd may follow his dog and sheep to the sheep-pen. The public or audience should, if possible, be placed on a hill overlooking the interesting work; the onlookers should be kept away, at

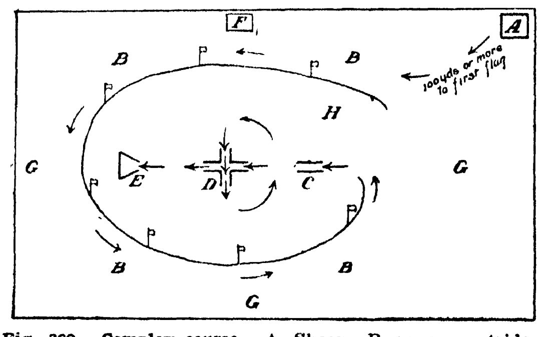

Fig. 399. Complex course. A, Sheep; B, course, outside of flags; C, single hurdles; D, Maltese cross (double hurdles); E, pen; F, judges; G, public; H, shepherd, who may move anywhere inside the flags. Time allowed, say seventeen minutes.

all costs, from the actual arena. Sheep are stupid; they become more and more so with a strange dog, and midst the shouts of approval and groans of disappointment that ever and anon arise from the advocates at these exciting events. There is not a slow moment at a good sheep-dog trial.

FISH. *Pisces.* Figs. 400–403.

The agricultural utilization of ponds and streams as sources of food income has scarcely yet begun in this country. The time must come when they will be as carefully utilized as the fields of the farm; in fact, they themselves will become farm fields, yielding their regular product of food as certainly as the poultry yard yields its fowls or the pasture its sheep. There is more or less breeding of fish at present, but largely of game fish, from the sportsman's point of view; this point of view must be radically changed before water agriculture can attain great efficiency. We have not yet begun to domesticate fish in this country, although this has proceeded in the Old World with the carp, which is thus far the leading agricultural species. We shall some day have domestic breeds of more than one species of fish.

Aquiculture is the cultivation of animals and plants that live in water, or whose habitat essentially comprises a body of water. The animals may be gill-breathers, as fishes and mollusks, or lung-breathers, as frogs and turtles. The microscopic organisms that are the food of so many aquatic animals, such as sponges, clams, and the young of fishes, constitute the plankton. [See page 393.]

It is not the province of this cyclopedia of agriculture to discuss fish at length. Brief attention is given to the general subject of fish-culture and fish-food, and to some of those kinds of fish for which artificial methods of propagation have been undertaken. The reader is referred to *Shell-fish* for discussions of raising clams, crabs, crayfish, lobsters, oysters and shrimp. He may also wish to consult the articles on *Frogs*, *Sponges* and *Turtles.*

Fish-culture. Fig. 400.

By *W. E. Meehan.*

The artificial propagation of fishes, under the direction of the Federal Bureau of Fisheries and state commissions, has become an extensive industry. Rivers, lakes and ponds, depleted of their fishes, are now commonly restocked with food and game fishes from the hatcheries of the state and national fish commissions.

Fish-culture of some kind was practiced by the ancient Romans and also by the Chinese and Japanese. The Romans built artificial ponds opening into natural waters, and when the former were stocked, screens were placed at the outlets so that the fish could not escape. The Chinese and Japanese gathered eggs of wild fish from one body of water and carried them to another, where they hatched. They also engaged in the systematic culture of goldfish, and by selection produced what are now known as "fancies," that is, fish with more than one tail and with abnormally shaped bodies. It is supposed that this condition was produced by agitating the eggs at a certain stage of development.

Artificial fish-culture was first employed in the latter part of the fifteenth century by a Jesuit priest, but it was put to no practical use. It was revived again about the latter part of the seventeenth century by Jacoby, a German scientist, who published a paper on the subject. This paper was afterwards translated into French and English, but even this was not followed by practical efforts. It was not until about 1840 that fish-culture was definitely undertaken. Its beginnings were brought about through experiments made by two Breton fishermen, named Remy and Gehin. They made a close study of the spawning habits of the trout, and took eggs and devised an apparatus for hatching them. The attention of the French government was drawn to their experiments, and Gehin was made a commissioner to teach others the art of artificial fecundation and hatching of fishes. A year or two later, experiments in artificial fecundation of salmon on the lines laid down by Jacoby and Remy and Gehin were successfully undertaken in Scotland by two Scotchmen. Later, the work was introduced into the United States by private individuals, who had studied the methods of Remy and Gehin. Shortly afterwards, Seth Green, of New York, who may be considered the father of fish-culture in America, established a hatchery and undertook the propagation of trout on a large scale. He subsequently experimented with the artificial hatching of shad and brought it to a successful issue. Livingston Stone, also of New York, followed Seth Green's work closely and established a hatchery.

The rapid reduction of fishes in this country, especially in the New England and Middle states, caused much concern, and about 1866 a general convention, composed of delegates appointed by the authority of the legislatures of the several states, was held with a view of devising means to restore the fisheries. The result of the convention was the establishment of fish commissions in the various states and by the United States government. Both the national and the state governments constructed fish hatcheries or stations where fish could be propagated artificially. The energies of the states were at first directed principally towards the hatching of brook trout, while the United States Fish Commission, although making a specialty of this fish, sought a broader field. Little by little other states followed the example of the National Fish Commission, until some of the commonwealths, notably Rhode Island, New York, Pennsylvania, Michigan, Ohio, Wisconsin and Minnesota, are propagating most of the more valuable game and food fishes within their borders. Pennsylvania and New York are especially active in this particular, the former even undertaking the culture of such fishes as catfish, pickerel and sunfish, in addition to what are commonly called the higher forms, as trout, shad, wall-eyed pike, whitefish and black bass.

The science of fish-culture is advancing rapidly, and, while there is yet great advancement to be made, it is now generally conceded that it is chiefly a matter of the amount of money available for the work.

Systems of fish-culture.

There are three distinct lines of work in fresh-water fish-culture: First, the artificial taking, fecundating and hatching of eggs; second, the natural spawning of fish in artificial ponds in fish-

hatching stations; and, third, the catching of fish from one body of water and transferring them to others, and the taking of wild eggs and artificially hatching them.

Artificial fecundation and hatching of eggs.—In the first system, two methods are employed,—the use of open troughs and trays and the use of jars.

(1) *The open trough and tray system* is used largely for the artificial hatching of salmon and trout. The general form of the troughs used by the United States Bureau of Fisheries and by the several states is to all intents and purposes the same, the chief difference being in the size. The majority of the states employ a trough twelve to sixteen feet in length and about thirty inches wide, with a division down the center, and about eight inches deep; but some of the states, and the United States Bureau of Fisheries, use a trough several feet in depth. Through the first type of trough six to nine quarts of water flow per minute. The eggs, after being fecundated and thoroughly cleaned, are spread on wire-mesh trays, previously painted with asphaltum, or in wire baskets especially designed. In the shallow type of troughs there is set but one, or at most two tiers of trays, but in the deeper types as many as sixteen or more may be placed.

After the fish have hatched, they are often retained in the troughs until the sac is absorbed, and then either planted in the streams or transferred to outside ponds and held until the fish-culturist deems it proper to plant them. The period of planting varies, some culturists planting the trout while the sac is still attached, some when the sac is first absorbed, others when the trout arrive at the fingerling stage, while others hold them until they are about eight or nine months old.

(2) *Jar system.*—The jar work was formerly conducted under what was known as the table system, which is still pursued by some states and to some extent by the United States Bureau of Fisheries. The table system consists of a table in which is set a tank, around which are placed glass jars having hermetically sealed caps. Water is introduced into the jars, by means of rubber and glass tubes. There are two tubes for each jar; one reaches nearly to the bottom of the jar for the introduction of the water, and the other, shorter one, carries the water into the tank from the jar; the latter is also used to siphon out all the young fishes and the dead eggs. Eggs are placed in the jars and the water kept constantly flowing, so that the eggs will be in perpetual motion during the development of the embryo. The period of development of the embryo depends on the species of fish and the temperature of the water. Some fishes, as the shad, under certain conditions will hatch in four or five days; others, as the whitefish, will require three to four months.

The table system is being abandoned for the battery system (Fig. 400), for the reason that the latter is simpler and a larger number of eggs may be hatched in a smaller space and with no more water. A battery consists of a series of troughs about twelve inches deep and twelve inches wide,

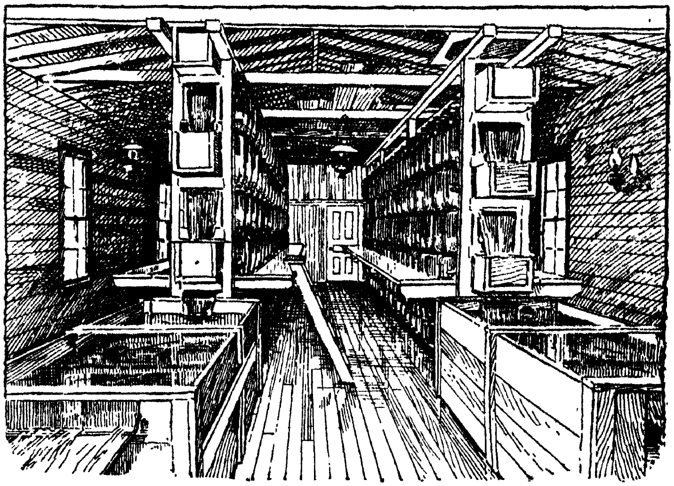

Fig. 400. Interior of a fish-hatching house equipped with battery and jars, the latter showing the eggs.

and of a length corresponding to the size of the hatching-house, set one above the other from the floor to near the ceiling. There is another type of battery in which the troughs are set step-fashion, but the former method is in more general use. The water is introduced into the top trough, from which it flows to those beneath and finally into a large tank at one end of the building. Faucets are inserted at intervals on each side of the troughs, from which water is carried by short pieces of rubber hose attached to the glass or tin tubes that reach to the bottom of the jars. The top of a jar is open and the water flows out from a lip back into the troughs, carrying with it the dead eggs and young fishes, which afterwards flow into the tank just mentioned. Several designs of jars are used, according to the fancy of the fish-culturist, but each type holds about four quarts of eggs. The jar system is used for the eggs of such fishes as the whitefish, shad, yellow perch and pickerel, which are deposited in vast quantities but are much smaller than the trout.

Spawning of fish in artificial ponds.—The pond system is for fish from which the eggs either cannot be taken artificially, or from which it is difficult to take them. The principal species for which pond work is undertaken are the black bass, both large and small mouth. The artificial culture of black bass is comparatively but a few years old, and is still largely experimental. Originally the ponds were relatively small, but with growing experience they are being enlarged, until now, many fish culturists advocate bodies of water three to five acres in extent.

A bass pond for breeding purposes should have

a shelf extending over the greater part of the pond at an average depth of a foot and a half to two feet, and a kettle with a depth varying from two to eight feet, according to the climate of the region, whether the winters are very severe or are mild. The shelf is for the spawning grounds, and the kettle for hibernating and refuge. The nests are artificially made of coarse gravel and small stones. About these nests is set a wooden screen with two sides open. The two closed sides are to prevent fish in one nest from seeing fish in another. On these nests the fish deposit their eggs. The usual practice is to permit the eggs to be incubated under the care of the fish, and as soon as they are hatched, the wooden screen is taken away and replaced by a crib having a frame-work of iron or wood, and the sides covered with cheese-cloth. When the sac is absorbed, the little fish are transferred from the crib to fry ponds, in which there is a large amount of aquatic plants of species on which low forms of aquatic animal life thrive. On this vegetation the young fish feed. When they are of a certain size, they are planted in the streams.

Field-work.—The third method, which is usually called field-work, is divided into two distinct operations: one, the catching of wild fish by means of nets and transferring them to other waters; the other, gathering the spawn or eggs of fish naturally deposited, and transferring them to hatcheries to be developed either by the jar or the trough system. The gathering of wild eggs for hatching is looked on as very important, since it saves a very large number of eggs that would otherwise be destroyed by spawn-eating fish.

Literature.

There is very little important literature relating to fish-culture. Domesticated Trout, by Livingstone Stone, is a good contribution of the earlier days. The latest reference of value is the Manual of Fish-Culture, issued by the United States Fish Commission, first in 1897, and revised about two years later. See also, C. H. Townsend, the Cultivation of Fishes in Natural and Artificial Ponds, Reprint from Eleventh Annual Report of New York Zoölogical Society.

Fish Food and Feeding-grounds.

By *James G. Needham.*

The food of fishes is almost as diversified as is the life of the waters they inhabit. Our best native game fishes are carnivorous. Some of them (as pike, black bass) eat chiefly other fishes, mostly of smaller size. Some, as the brook trout, that normally feed in part on other fishes, may thrive on insects alone in a pond where these are abundant. The sheepshead of our inland streams eats chiefly mollusks. Its broad, flattened teeth are well adapted for crushing snail and mussel shells. All our bottom-feeding fishes eat more or less of the various crustaceans, insect larvæ, snails, worms and the like, that occur in such places; and all fishes, when very young, eat largely the free-swimming life of the open water, that is collectively known as plankton. Plankton organisms continue to be through life the food of a few fishes, even of some of the larger ones, such as the spoon-bill (*Polyodon*).

Fishes may take food with the water they inhale, if their gill-rakers are fine enough to strain out of the water the minute organisms it contains; such food, although it may be considerable in quantity and importance, comes to them with as little seeking as the oxygen dissolved in the water for their breathing. But the demands of appetite usually impel them to make conscious efforts to capture larger game, and nature has endowed them variously to accomplish their special needs: with sharp, hooked teeth, as the bass, for capturing other fishes; with grinding teeth, as the sheepshead, for crunching snail shells; with upturned jaws, as the grass pike, for picking insects from the surface of the water; or with down-turned and pursed lips, as the sucker, for drawing worms up out of the ooze of the bottom. Some mud-eating fishes (that live on the rich organic materials contained in the mud) of great reproductive capacity, are important as furnishing in their offspring a supply of food for the other piscivorous sorts, as the native gizzard shad of our sluggish inland rivers, and the imported "German" carp. (Figs. 401–403.) Almost the only fresh-water fishes that are fully protected against being swallowed by others are the catfishes, whose three stout rigidly-erected spiny fore finrays appear to be adequate defense, and the stickleback.

But one reliable method of determining what fishes eat has yet been found,—that is the examination of their stomach contents. By this means it has been determined that the food of our best fishes is predominantly smaller fishes, insects and crustaceans; that the largest percentage of their food is insects, and that by far the most important part of their insect food is the immature stage of may-flies and midges.

Very little is yet known of the conditions that make for abundance of fish-food. Plankton organisms live in the open water, but different waters vary wonderfully in the richness of their plankton. The supply they furnish varies also with the season, but it is a part of the balance of nature that the supply is in all waters most abundant at that season (spring) when the majority of fishes, being newly hatched, are dependent on it. Most of them will turn to other food when they attain to larger size. On the bottom, in deep waters, there is a scanty fauna consisting chiefly of a few forage organisms, as "blood worms" (larvæ of midges of the genus *Chironomus*), "caddis-worms" (larvæ of the caddis-flies), and small bivalve mollusks (*Pisidium*). Some of our best fishes, such as whitefish and trout, forage largely there. The dense beds of submerged waterweeds that grow on trash-strewn bottoms in slack water, are probably the richest in organic life of all fish-foraging grounds. These shelter teeming hosts of mollusks, crustaceans and insect larvæ. The smaller fishes swarm here, to be nabbed on the outskirts of these beds by the larger piratical fishes that dwell in the deeper water. It is noteworthy that these submerged meadows (beds of *Chara*, *Ceratophyllum*, etc) are not browsed on

directly by water-animals, as are clover-fields by cattle; on the contrary, they grow green, and grow old and die almost untouched, and the herbivorous water-organisms (with the exception of a few caddis-worms, and others) eat them only after they are dead and disintegrating. The primary source of organic food for the large aquatic animals is, in the water, dead plants instead of green plants, as on land. The most important producers of valuable fish-forage thus appear to be a few herbivorous crustaceans and larvæ of may-flies and midges; and the best foraging grounds, those submerged meadows in whose shelter and nourishment these forms develop in greatest abundance.

Literature.

S. A. Forbes, The Food Relations of Fresh-water Fishes, Bulletin of the Illinois State Laboratory of Natural History, Vol. 2, pp. 475–538; J. G. Needham, The Food of Brook Trout in Bone Pond, Bulletin No. 68, New York State Museum.

Plankton-Culture.

By *Julius Nelson.*

Plankton consists of very simple or microscopic organisms of water, both plant and animal. These organisms are very numerous, and are usually distributed throughout the body of water, being passively carried by its currents. The plant-cells, nourished by the minerals in solution, and bathed by sunlight, multiply rapidly, furnishing food for the microscopic animals; and both groups of organisms are the food of sponges, mollusks, polyps, and the young of nearly all aquatic animals, including the fry of fishes and the tadpoles of amphibians.

Successful attempts have been made in France in breeding plankton for both fish fry and for fattening oysters (which see). The general method employed is as follows: Shallow ponds are chosen (or excavated), into which the flow of water may be controlled, whether fresh or salt. For a few weeks in the spring, such ponds, or *claires*, should be emptied, and the bottom baked in the sun. Then follows spading and raking, after which the pond is allowed to fill gradually. The water, having no exit, becomes warm and remains stagnant, and its plankton increases. Then the ponds are filled, and the oysters or fish are introduced. For fish-culture, a series of such ponds are in readiness, are pastured successively, and replenished by intervals of rest.

The United States Bureau of Fisheries has successfully conducted experiments in the application of fertilizers to ponds for oyster-culture, and has thereby so increased the growth of oyster food that three or four weeks' sojourn of poor oysters in such ponds has fattened them for market.

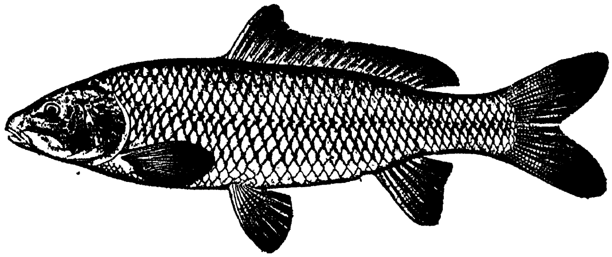

Fig. 401. Scale carp.

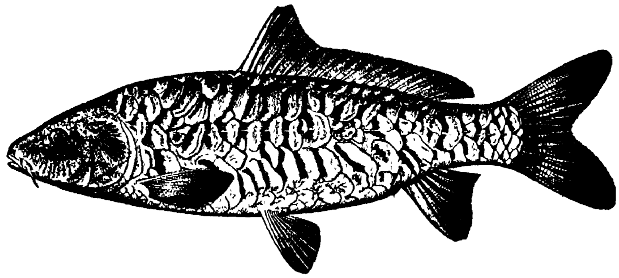

Fig. 402. Mirror carp.

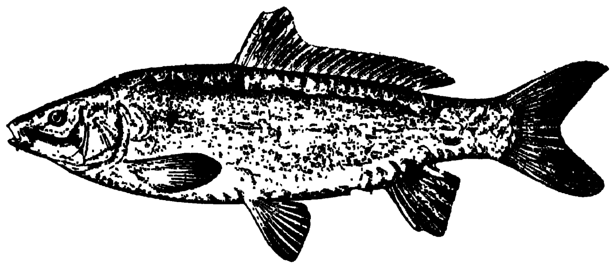

Fig. 403. Leather carp.

Figs. 401–403, varieties of the domestic carp.

Carp. *Cyprinus Carpio,* Linn. *Cyprinidæ.* Figs. 401–403.

By *J. G. Needham.*

The carp is the one food-fish that may fairly be considered domesticated at present. In common with most of our domesticated animals, it is a native of Asia. It was introduced into this country from Germany over thirty years ago, and is already one of the most widely distributed fishes in America. It has been cultivated in ponds in Germany for a long time, and exists there in several improved cultural varieties. There are three fairly well-known varieties in our own waters, all of which are German carp: besides "scale carp" (Fig. 401), the parental stock, which is uniformly covered with scales of moderate size, there is the "mirror carp" (Fig. 402), which has very large scales irregularly disposed along the sides of the body, and the "leather carp" (Fig. 403), which is almost scaleless. But as these forms have often been liberated in the same waters, unrestricted inter-crossing has resulted in all sorts of varietal intergradations.

Feeding habits.

The carp is adapted well for life in farm ponds and mill dams, where there is a muddy bottom and an abundance of waterweeds. It is not well adapted to clear streams or spring ponds, and should not be introduced into such places; to such

waters, our native game fishes of finer flavor are better suited and are far more desirable. The young of these, when ready for planting, may be obtained from the state fish hatcheries.

The carp is omnivorous in its feeding habits. It eats the roots and soft stems of aquatic plants, pulling and tugging at them and tearing off shreds that may be swallowed, and often uprooting small plants and leaving them floating. In this way more or less damage is done in exterminating eelgrass (*Vallisneria*) and other aquatics. It eats the soft parts of dead plants also and swallows considerable quantities of mud, rich in organic remains. It "roots" around in the pond bottom to dislodge bottom crustaceans and insect larvæ. In consequence of these habits, it should not be allowed to become over-abundant in waters in which the native life is to be preserved. The foraging habits of the carp on the pond-bottom may be likened to those of hogs, "rooting" in a pasture, and over-pasturing produces like destructive results with both.

Food value.

The flesh of the carp, when properly prepared, from fishes that have had reasonably clean forage, is excellent, although probably never so delicious as that of the best of our native game fishes. Carp will thrive where these will not live at all, and for the vast areas of our country that are remote from the seaboard and the mountains, will furnish, perhaps, the best supply of table-fish available. To prepare carp in the best manner for the table, it should be both skinned and drawn, soaked in salt water over night, then boiled, and finally baked with proper dressing.

Stocking streams with carp.

Ponds and streams may readily be stocked by introducing a few adult fishes of both sexes, which have been seined in the spring before their spawning season. The spawning time is early, in May and June. The eggs are produced in vast numbers, each female laying several hundred thousand. They are scattered over the vegetation, and on the bottom in shallow water. They hatch very quickly, if they escape being eaten, and grow very rapidly, attaining maturity in about three years. While young, they may furnish an abundant food-supply to carnivorous fishes, as the black bass. The latter, of entirely different feeding habits, is a native fish that thrives in the same waters with the carp.

There is no doubt that in some of our inland waters, such as the Illinois river, with its slow current and muddy bottom, the production of marketable fish has been greatly increased as a result of the introduction of the carp, and many a lesser area of water of similar character, now producing nothing of value, might be made to yield excellent food, if carp were planted in it.

Literature.

L. J. Cole, The German Carp in the United States, Bureau of Fisheries, Washington, D. C. (1905).

FROGS. *Rana* spp. *Ranidæ.* Figs. 404, 405.

By *W. E. Meehan* and *E. A. Andrews.*

The Report of the Fish Commission for 1897 contains an estimate that the annual catch of frogs in the United States is a little less than one million frogs, worth $50,000 to the hunters and $150,000 to consumers. Reference is also made to a "frog-farm" in Ontario that had been running for twenty years, and in 1895–6 yielded 5,000 pounds of dressed frog's-legs for market and 7,000 living frogs for stocking other waters and for scientific purposes.

With reference to the possibilities of artificial culture of frogs the report concludes as follows: "While at present it would perhaps be advisable to limit practical attempts at frog-culture to stocking natural waters with paired breeders, experiments in artificial methods should not be abandoned. There seems no reason why methods similar to those at present pursued in fish-culture may not eventually be successful in the case of the frogs."

The more specific statistics of the United States Bureau of Fisheries for 1902, 1903 and 1904, show an annual business of 345,759 pounds of frogs, worth $26,327, and distributed as follows: Mississippi river, 285,811 lbs., valued at $15,604; Illinois river, 7,255 lbs., valued at $2,053; Red river, 1,850 lbs., valued at $279; North Carolina, 5,990 lbs. (11,980 individual frogs), valued at $599; Virginia, 3,220 lbs., valued at $690; Lake Ontario, 500 lbs., valued at $250.

While it is doubtless true that a very great many thousands of dozens of frogs are annually sold to hotels by a single commission merchant, many thousands also sold for bait and perhaps one thousand dozen to schools and laboratories, all these sales and statistics relate almost exclusively to frogs that are hunted and caught in nature, and do not indicate the existence of any frog-farming industry. Attempts to discover the numerous "frog-farms" exploited in the newspapers generally show them to be non-existent. Most of the so-called "frog-farms" are at best places for holding wild stock and are not breeding-places.

Pennsylvania experiments.

Until recently little or no systematic effort was made in the United States to cultivate frogs for the market in the same manner as certain species of fishes. A few persons had attempted to rear them in a perfunctory way, but without system. Pennsylvania, through its Department of Fisheries, was the first to make persistent experiments in scientific frog-culture, and to solve some of the difficulties that lie in the way of success. The initial work was begun in 1899, in one of the State Fish Hatcheries, but failures were met with until 1904, when 40,000 young were developed from wild eggs. It was not until 1906 that breeding frogs were carried through the winter successfully and spawn taken from them and hatched. As a result of persistent experiments and investigations conducted at all the Pennsylvania hatcheries, the conclusion is reached that the mortality among wild tadpoles

must be enormous. It is very heavy in the hatcheries, where the best conditions for successful rearing prevail.

Edible species.

There are thirteen edible species of frogs in America, with rather more than half a dozen subspecies or varieties. In the eastern United States, there are at least three species of edible frogs, the common bullfrog (*Rana catesbiana*), the green frog (*R. clamitans*) and the spring or leopard frog (*R. virescens*). The first named is the largest frog and the last the smallest, but the leopard frogs offer the best chances for successful cultivation because of their gregarious character, which the others do not possess. In the case of most of the smaller frogs the present abundant supply of wild material makes attempts at rearing them unprofitable, but in the case of the largest known frog, the American bullfrog, the natural supply being apparently doomed to exhaustion and the market prices high, the experiment of rearing for the market is promising.

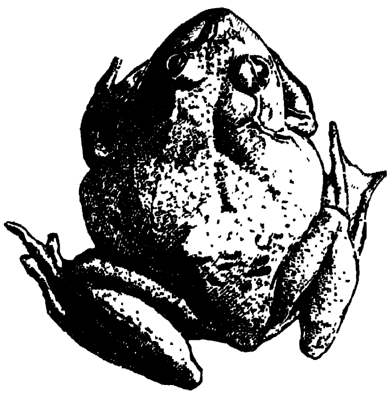

Fig. 404. Bullfrog (*Rana catesbiana*).

Points to be observed in frog-farming.

Experiments in the different state hatcheries in Pennsylvania have demonstrated that tadpoles, young frogs and mature frogs must be kept separate; that while tadpoles will eat dead animal food, frogs will eat only living things, preferably insects; that ponds for tadpoles should contain grasses, and those for young and old frogs must be liberally provided with water-lilies and other flowering water-plants to attract insect life; that all ponds must be surrounded by tight boards or mosquito-wire fences to prevent frogs from escaping; that overcrowding, even in the tadpole stage, is fatal; that ponds for tadpoles should have and those for frogs must have a soft mud bottom below the reach of freezing, in which the creatures may hibernate.

Fig. 405. Leopard frog (*Rana virescens*).

In the life-history of the frogs, the early part, the tadpole, presents no difficulties, since they may be readily fed on cheap animal or vegetable matter; but later, when they have left the water, the hopping frogs require live animal food. They need to be kept for two or three years before being marketable. As yet no adequate substitute for the natural food, which is largely insects, has been found, and therefore only a limited number of frogs can reach maturity in a large enclosure. The bullfrog, especially, requires a large range to obtain food enough and to escape the diseases that come from crowding, as well as to diminish the losses from frogs eating one another.

Frogs in the northern United States spawn first in April and early May. The eggs hatch in a few days, and if the water is not too cold and there are rest places, the period of development into a perfect frog is, in some species, about three months. Frogs mature in two to three years. Eggs are also secured in July and August, but the tadpoles hatched therefrom do not complete development until the following spring.

Ponds for tadpoles may be about sixty feet by twenty feet, but ponds for young and mature frogs should be at least half an acre in extent. Not less than three acres is required to assure the farmer a satisfactory income. Any swamp or other ground into which water can be introduced may be utilized for frog-farming.

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FUR-BEARING ANIMALS OF NORTH AMERICA. Figs. 406–414.

By *E. T. D. Chambers.*

The fur-bearing animals of North America meant more to its original inhabitants than do all the flocks and herds of the present day to our agricultural community. They constituted their chief source of food and raiment. It was the chase and the barter for their pelts that drew the earliest European adventurers across the ocean. From the very inception of colonization in the New World, the fur trade has been associated with its industrial and commercial development, and indirectly with its social life, its romance and even its early wars.

Extent of the industry.

The rapacity of comparatively modern dealers in and hunters of furs is responsible for the all but total extinction of the buffalo and the sea-otter, and for the vast diminution in the numbers of the Alaska seal herd; and yet despite the steadily diminishing proportion of much of the annual output of material for furs, America's fur-trade is more important now than it was in the palmy days of the old-time hunters and trappers.

In many parts of Canada, as well as in the United States, there has been an enormous decrease in the supply of beaver. The sea-otter, which formerly furnished 100,000 skins annually, now yields less than 400, and the average number of Alaska sealskins marketed has decreased from 100,000 to 10,000 per annum. Other fur-bearing animals have taken the place of these to such an extent, that according to statistics furnished by

United States Vice-Consul Burrell, stationed at Magdeburg, more money is now earned on skunk, muskrat and fox skins, than ever before on beavers, sea-otters, seals and other rare furs.

On the American side of the line, the volume of the fur trade is the largest ever known in the United States—greater than in the days when the buffalo and the beaver had the whole continent as a stamping ground. Its annual value runs into the millions of dollars. Half a million opossum skins are annually shipped from America to Europe, and a still larger number of raccoon are sent across the Atlantic from the northwestern states alone. Michigan, Wisconsin and Ohio, and the group of central-northwestern states furnish 600,000 skunk skins annually to commerce, while 50,000 Alaskan fox skins of all sorts find their way every year to the great trade sales of furs at London, Leipzig, and Nijin-Novgorod. The number of American foxes taken by trappers may be judged from the fact that Maine alone furnishes 70,000 a year. Hundreds of thousands of rabbits are trapped yearly in California, and millions of muskrats are contributed from the swamps of New Jersey and Delaware, to the value of half a million to a million of dollars annually, in addition to those produced by the states lying immediately to the south of the great lakes. Of the half million or so of mink skins exported every year from North America, the United States contributes a fair share, although the larger number go from Canada.

Many Canadian furs pass into the hands of American traders, through St. Paul, St. Louis, Chicago or San Francisco, to either a home or a foreign market as the case may be.

The home market is responsible for the consumption of an enormous amount of native fur, in addition to the importations of Persian lamb, Russian sable, astrachan, monkey and others. The consumption of raccoon for men's coats, especially in Canada and the northern states, of mink and muskrat for linings, of mink, marten and otter for trimmings, in both countries, and of skunk manufactured into Alaska sable, for muffs, tippets, boas and the like, is very great, and would largely increase the total of the annual product, if added to the figure of North America's actual export of furs. It is because of the impossibility of estimating the home consumption that figures are not available to show the aggregate annual value of the North American fur catch. Miss Agnes Laut states that an estimate of $6,000,000 placed on the annual value of furs north of the forty-ninth parallel would not be sufficient to include what has been used for the home market. In Canada, as in the United States, the demand for furs for local consumption is steadily growing. The rapid increase in average wealth places a set of furs in the category of reasonable luxuries of many, whose parents, living in an era when raw furs were more plentiful, wore mainly homespun. But these must not all be placed to the credit of local supply, for while, as in the case of the United States, many native furs are manufactured in Canada for domestic use, and while a considerable proportion of the best furs worn in the country are reimported from Europe as finished articles, after having been exported as raw material, many firms annually send buyers to the Russian and Asiatic markets to purchase raw furs, which are not procurable on this side of the Atlantic, but which are made up here.

As much, perhaps, to the growing fashion of wearing furs as to the decreased supply of fur-bearing animals is due the rapid increase in the values of domestic furs in the last few years. Canadian otter, which sold a quarter of a century ago for $2 to $8 per skin, and five years ago brought $15 to $18, is now (1908) worth $30 to $50. Mink skins sold freely in 1882 at 25 to 75 cents each, and the primest could be bought for a dollar. At present, the wholesale manufacturing establishments will pay $10 for a prime skin. Marten that sold for $1 to $4 per skin 25 years ago, and at $5 to $6 half a decade ago, is now worth $10 to $35. Muskrat skins only a few years ago could be had in large quantities for 3 to 8 cents each, and are now worth 10 to 50.

Protection of fur-bearing animals.

With a constantly increasing home demand for furs, it is satisfactory to note from the reports of traders that the fur-bearing animals of the last great fur preserve in the world, as the northern part of North America has been called, are by no means becoming extinct. These hunting-grounds are for the most part in the hands of Indian and half-breed hunters, who would no more think of destroying the last beaver, fox, mink or marten on their respective territories, than would a farmer of killing off the last of his breeding stock. They only thin out the animals which they hunt, in such numbers as to ensure the permanency of the supply. In Labrador, in the Mackenzie river basin, and in other northern parts of the continent, the territory hunted by each Indian family is as much its own for hunting purpose as is a farmer's field for cultivation. Some hunters have several hundred square miles of territory in their respective game-preserves. Bears and caribou and such roaming animals are killed wherever seen, if wanted, but beavers and similar game and fur-bearing animals that inhabit restricted areas are the property of the hunter within whose territory they reside and breed. For any but their owner to kill them, except in case of absolute want of food, would be as unjustifiable as the shooting down of a neighbor's ox.

Further protection is afforded the most valuable furs by the trade itself and by the dictates of fashion. The trade does not care to purchase at all the furs of animals killed out of season, so that the hunting-season that pays does not often extend more than four or five months of the year. Fashion is particularly fickle in regard to furs, so that the seasons in which there is but small demand for a certain class of skins afford opportunity for a satisfactory increase in the number of the animals producing them, since the hunters are aware that better paying prices are to be had for other furs.

Where they are found in largest numbers and the greatest necessity for protection of fur-bearing

animals exists, they are usually afforded it by legislation. Nearly all the provinces of the Dominion of Canada, as well as Newfoundland, have enacted laws for such protection. In the United States, the majority of the states in which squirrels are found afford them some protection at least. The rabbit is protected, or partially protected, under the laws of Delaware, District of Columbia, Indiana, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Rhode Island, and Vermont. The otter has been legislated for in Iowa, Minnesota, Missouri, Nevada, New Hampshire, North Dakota and Wisconsin. For the beaver, protective legislation has been enacted in Idaho, Iowa, Maine, Minnesota, Missouri, Nevada, New Hampshire, New Mexico, New York, North Dakota, Pennsylvania and Vermont. There are closed seasons for bears in Alaska, New York and Pennsylvania, and the little mink is similarly protected in Iowa, Maine, Minnesota and New York.

Fur-hunting.

The story of the fur-hunter and trapper contains many of the most thrilling pages to be found in the realms of human daring and adventure. Many lives are sacrificed in the annual hunts for skins of the sea-otter and Alaska seal in the northern Pacific, and for the Greenland or hair-seal amid the ice-floes of Newfoundland waters and in the gulf of St. Lawrence The dreary wastes of Labrador and of other far northern regions of the continent of North America hold the bones of hundreds of Indian hunters who have perished of starvation and disease on their annual fur-hunts, through the unexpected failure of the game on which they have depended for a part, at least, of their food supply. As late as the winter of 1906–7, a number of Montagnais hunters and their families perished of hunger while on their way from the vicinity of Lake Mistassini to the Hudson Bay station at Lake St John.

Let us follow a party of these Indian trappers as they start out from the Hudson Bay post at Lake St. John, Bersimis, or some of the other posts on the coast of Labrador. The journey is made by canoe and portage, and the provisions and firearms, and sometimes the traps, too, as well as tents and other equipments, must all be conveyed to their respective hunting-grounds before the winter sets in and makes the journey by water impossible. Sometimes the journey is over one or two hundred miles in length, and may occupy several weeks, because of the many portages and the quantity of provisions, ammunition, and the like, that must be carried over them. There is the family tent, too, which serves as dwelling on the way, and sometimes throughout the entire winter, although some of the more provident hunters erect log huts on their preserves. The provisions carried are rarely sufficient for the entire winter. For fresh meat the trapper counts on caribou, deer, hares, rabbits and partridges, and perhaps on an occasional bear. But hunting is always a more or less precarious pursuit, and when there is an entire failure of game, as not infrequently occurs, privation and hunger result, sometimes accompanied by deaths from actual starvation. Instances are on record in which starving bands of Indian hunters in the far North have been able to maintain life only by the awful expedient of feeding on the flesh of the first victims of their sad plight.

Arrived at their winter headquarters, the hunters set out their line of traps,—deadfalls or steel traps, or both, as the case may be,—and thereafter spend the short winter days in visiting the long line, sometimes many miles in length, rebaiting them when necessary and securing the catch that any of them may happen to contain. The bear and the beaver make luxurious prizes, for, in addition to the value of their skins, the carcasses mean a bountiful supply of delicious food. Even the muskrat is not despised as an article of diet.

Sometimes a successful hunter makes enough money out of a season's trapping to pay off all his debts to the company and have a good balance to his credit. It more often happens, however, that the Indian is always indebted to the company or trader who outfits him, and to whom he must bring his catch of furs in payment of a part of the goods which he purchased during the last summer he was out at the coast, and of the clothing, ammunition and provisions which he took with him into the woods on the approach of the hunting-season. At times, too, the hunt completely fails, or a carcajou (wolverine), well called the Indian devil, falls on the hunter's line of traps, after which he may just as well give up the hunt altogether, unless he has the exceptional good luck of entrapping the cunning beast, which, with almost devilish ingenuity, has the knack of springing the traps and safely extracting the baits, or will immediately devour any other animal that he may find entrapped. When the hunting-grounds are only a few days' journey from the coast or a settlement, the hunter will often come out of the woods for the midwinter holiday, and take in more fresh provisions with him on his return. In the majority of cases this is impossible, however. In the woods he has enough to do to keep him busy. There is game to be hunted for food and wood to be cut for fires. There are the traps to attend and to keep set, and when the hunt is good there is the preservation of the skins to be attended to. When these have been stripped from the bodies of their first wearers, they are stretched on hoops or other frames to dry, it being very necessary that they should be preserved from decay. Very valuable are some of the otter, marten and mink furs secured in these northern wilds, and sometimes a cross or even a black or silver fox may be taken, the skin of which may easily exceed in value that of the hunter's combined catch of other furs.

Hunting sea-otter and seal.

Sea-otter.—The story of the sea-otter (*Enhydra* or *Latax marina*) reads like a romance. In the days when this furred sea-dog of the Pacific ocean was plentiful. it could be shot by still-hunting in calm weather as it came to the surface of the water to breathe. Now it must be hunted in the teeth of

the wildest Alaskan gale. "The native Aleutian," writes Miss Laut, "rides out in his skin-skiff, with oiled-skin wrapping his body tight round the little manhole where he sits in the skin covering, so that the boat can take no water. Double-bladed paddle plying from side to side, the hunter mounts the seething waves and rides in on the back of the storm to the reefiest coasts of the Aleutians. Here the sea-otters have been driven by the storm, and hide with their heads buried in the tossing, wave-washed seaweed. Beaching his boat, the hunter runs from rock to rock, slippery as glass, beaten by the wind, sometimes caught by the waves and hurled to death. A single blow of his gaff-pole, and he has killed the sea-otter that supplies a fur more valued today than any other in the world."

The sea-otter is in shape very much like a large dog. Its food consists of fish, and it is particularly partial to lobsters and other crustaceans. Its fur was first introduced into commerce in 1725 from the Aleutian and Kurile islands, and is exceedingly fine, soft and close, jet-black in winter, with a silken gloss. The fur of the young animal is of a beautiful brown color. It was formerly met with in great abundance in Bering's island, Kamchatka, Aleutian and Fox islands, as well as along the Pacific coast of North America. In 1780, furs had become so scarce in Siberia that the supply was insufficient for the Asiatic demand. It was at this time that the sea-otter was introduced into the markets for China. The skins brought such almost incredible prices as to originate several American and British expeditions to the northern islands of the Pacific, to Nootka Sound and to the northwestern coast of America; and from that time has been the rapid decrease in the supply. Off parts of the coasts of Alaska, and especially at Belkovsky bay and vicinity, and at St. Paul, Kadiac island, sea-otter-hunting still furnishes employment to many native hunters. Here the animals are taken by means of bows and arrows, rifles and gill-nets. The nets are fourteen to twenty fathoms long, and twelve fathoms deep, with a ten-inch mesh. They are made by the Indian women, and are declared to be very destructive. At St. Paul, besides the Indians, there are some twelve or fifteen white men of various nationalities who engage in sea-otter-hunting throughout the year. The white hunters have small schooners of about twenty-five tons burden, in which they make long voyages. Some of these hunters are very skillful, and several thousand dollars have been earned by a single individual in a season. Captain Anderson, one of the most successful hunters of St. Paul, and, in fact, of Alaska, landed fifty sea-otter skins as the result of one trip a few seasons ago, receiving for them one hundred dollars each, which is very far below their present value.

Seal.—No set of fur-hunters enjoy more thrilling adventures or run such deadly perils as the sealers of Newfoundland and the gulf of St. Lawrence. Many are the sealing schooners and still more numerous the men who have gone out to the seal hunt in the spring of the year and never returned. The risks that they run are illustrated by the loss of the sealing steamer Greenland, in the ice, in the month of March, 1907. The disabled vessel had eighty-nine men on board, who abandoned the ship after she had been crushed in the heavy pack ice, against which she had been driven by a blizzard, and were fortunately rescued by other sealers. Only men of iron can successfully face and endure such dangers. They are so accustomed to the sea and the ice-floes that they seem to have an absolute contempt for their terrors. They leap fearlessly from pan to pan, and think little of passing the night on the ice far from the steamer, going off as far as four or five miles in their eagerness to slay. Should a fog or snow-storm set in, there is great risk of losing their way and perishing miserably in these ice-deserts, or of falling through the openings that are covered with the snow as it falls and freezes. Sometimes the field-ice on which they are at work separates into fragments without a moment's warning, and they are floated off, to perish by cold and hunger, unless rescued by a passing vessel.

Sealers' luck is just as uncertain as that of the average fisherman. One or more crews may be exposed to the perils of the ice for weeks without securing a single seal, while, under favorable conditions, five or six hundred carcasses may be secured in a couple of hours, by a crew of eight or nine men. This is when the schooners are fortunate enough to approach, unobserved, a large field of ice containing a herd of unsuspecting seals. The herds often include several thousands of seals. The ice is always approached from the side which is nearest to open water, so as to cut off the animals' only chance of escape. Then, at a given signal, the hunters leap on the ice and approach as closely to the seals as possible, without creating any alarm, sometimes even crawling a considerable distance on their hands and knees. As soon as they are observed, and can reach the nearest of the herd, the slaughter begins. Each man is armed with a stout stick, six to ten feet long, which not only assists him to leap, when necessary, from floe to floe of the floating ice, but with which he effects the slaughter of the defenceless animals. One blow over the nose suffices to kill, or at least to stun a seal, and as many as possible are disposed of, in order to prevent their escape; the final slaughter of the stunned ones beginning only when all the animals within reach have either escaped or been knocked on the head. The thin skull of the young seal is easily fractured by the blow from the stick, which may only stun the full-grown animal, and, in the majority of cases, the little one feels no more pain, death being instantaneous. In a moment the knife is at work. The skin and the adhering fat are rapidly detached from the carcass, which is left on the ice, except when the animal is killed close to the shore.

The catch of seals varies considerably with the season. Sometimes it exceeds half a million seals. At others it is only a quarter as good. Sometimes a steamer returns home at the end of the season perfectly "clean." The Neptune, on the other hand, after an absence of only eighteen days, came

into port in the spring of 1894, loaded down to the water's edge, with 42,000 seals, valued at $105,-000.

These *loups-marins*, or sea-wolves, of the gulf of St. Lawrence, as the French-Canadians call them, must not be confounded with the fur seals of Alaska (*Callorhinus Alascanus*, Fig. 406), whose soft coat

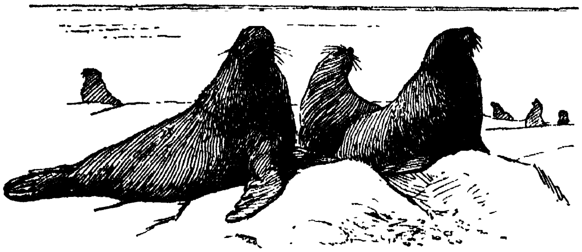

Fig. 406. The Alaska fur seal (*Callorhinus Alascanus*)

is one of the cherished possessions of the city belle. They are commonly known as the Newfoundland or hair seals (*Phoca Grœnlandica*). Until the last few years their skins were used chiefly for the manufacture of a coarse-grained but expensive leather; but in the last few winters, the fur has been extensively dressed in both Newfoundland and Canada, and coats and other articles of wearing apparel have made their appearance on the streets of Montreal and Quebec, made from this dark, rough, dappled-gray, or pepper-and-salt colored fur. As it is far from unsightly, and is uninjured by rain, it is altogether likely, in view of the now almost prohibitive price of the Alaska seal, that the Atlantic seal may rapidly pass into popularity and fashion.

The story of the fearfully diminished seal-herd of Bering's sea is matter of American history. In 1874, it numbered close on five millions. In less than a quarter of a century it had been reduced to a single million. In less than another decade, only 175,000 seals of the herd remained. Ten to twelve thousand skins a year are all that can be depended on from this source until protection may have contributed to an increase in the size of the herd. On the Pribilof islands, the Alaska seals are slaughtered by hunters with sticks, much as the hair-seal is on the ice-floes of the gulf of St. Lawrence.

The life-history of the seal, whether of the Pacific or the Atlantic ocean, is more familiar to the average reader than is that of the sea-otter, or of most of the fur-bearing animals of the interior of the continent. The fur or Alaska seal, formally known more generally as the South Sea seal, is the most perfectly organized of all the amphibians. It is obliged by its nature to secure its living in the water, and to reproduce its species on the land ; it therefore "hauls up," as it is technically called, at a stated period every year on the breeding-grounds where it is slaughtered for its fur. Its fore-feet or flippers are exceedingly broad and powerful, and when it comes out of the water it steps forward with considerable rapidity and much grace. It is an animal of great intelligence, speedily anticipating danger, and at the same time readily understanding when there is a disposition on the part of man not to disturb it. The full-grown males or bulls are the earliest arrivals at the islands, approaching them during the last days of April, and sleeping almost without interruption until toward the end of May, when they begin to look out for the coming of their families. The cows, or females, usually recognize their former mates and land at their respective rookeries. Owing to the great difference between the male and female in regard to the age of puberty, which is six years for the male, and two for the female, this species is necessarily polygamous, and an average family numbers ten to fifteen cows to one bull. The female gives birth to her pup almost immediately on landing. By the beginning of August, the breeding is nearly over, and the season of coition as well. Many young males attempt to land, but all below the age of six are quickly driven off by the old bulls, and sometimes even killed. The seals that are slaughtered for furs are carefully separated from the rest by men who walk between them before the killing begins. The females are spared, and so are the yearling bulls. The best skins are secured from two, three and four-year-old bachelors, and from those that arrive first on the islands.

Fur-bearing animals of the interior.

The more important of the fur-bearing animals of the interior of the continent are the beaver, the otter, the marten, the fox of different varieties, the bear, the lynx, the mink, the ermine, the muskrat, the skunk and the raccoon.

The beaver (*Castor fiber*, Linn., Fig. 407), which was formerly so abundant that its skin was the unit of currency for the Hudson Bay Company in its dealings with the Indian and half-breed trappers, has so rapidly disappeared that the yield is only half of what it was a few years ago. In the shape of its body it bears a close resemblance to a large rat, although it is much larger, with the head proportionately thicker and broader. It is thick and clumsy, gradually enlarging from the head to the hips, and then is somewhat abruptly rounded off to the root of the tail. This latter is very broad

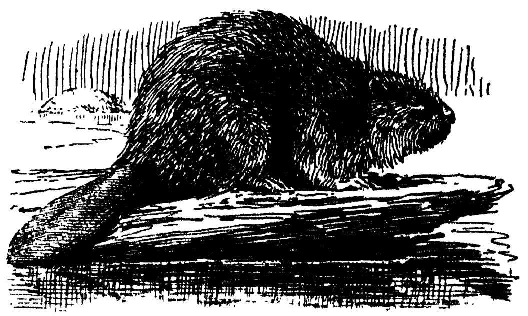

Fig. 407. Canadian beaver (*Castor fiber*).

and flat, tongue-shaped and covered with angular scales. The fur is of two kinds. The upper and longer hair is coarse, smooth and glossy; the under coat is dense, soft and silky. Its geographical range appears at one time to have been co-extensive with the whole of North America, although

the progress of civilization seems to have exterminated the animal in nearly all of that part of the continent which constitutes the United States and the settled parts of Canada. The remarkable dams constructed by the patient and industrious little animals show wonderful engineering skill. Cartwright found a beaver that weighed forty-five pounds, and it is said that they have been taken up to sixty pounds weight. The tail and other parts of the body are much prized by the Indians as articles of food. The animal is easily trapped.

The muskrat (*Fiber zibethicus*, Fig. 408) inhabits almost every part of the United States north of the 30th degree, and all British America to the arctic seas. It was fully described from personal observation, as early in 1725, by Monsieur Sarrasin, a correspondent of the French Academy, and then King's Physician at Quebec. Its habits are aquatic, and it spends the greater part of its time in the water, where it secures most of its food. The latter consists chiefly of fresh water mollusca, the roots of aquatic plants, and such tender grasses as may chance to grow at the margin of the stream. In addition to trapping them, the Indians sometimes take them by spearing them through the walls of their houses in winter. The shape of the body is almost cylindrical, and the length of head and body is about fifteen inches. The head is short, the neck very short and indistinct, the legs short, and the thighs hid in the body. The color of the animal so much resembles that of the muddy banks of the stream or lake on which it is often found seated, that, when seen from a distance, it is likely to be mistaken for a lump or clod of earth. On the upper parts of the body the fur is a third longer than

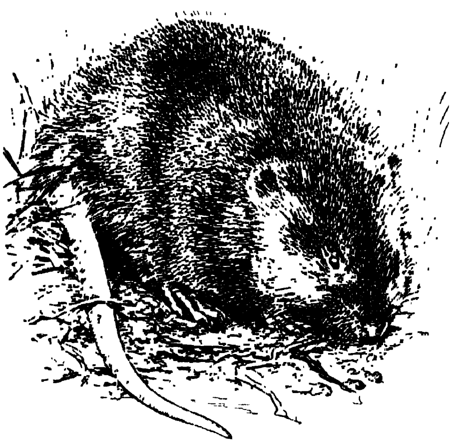

Fig. 408. Muskrat (*Fiber zibethicus*).

beneath, and from the roots to near the extremities is bluish gray or lead-color tipped with brown, giving the appearance of a general dark-brown color when viewed from above.

The mink (*Putorius vison*, Fig. 409) is widely distributed over the North American continent, but the largest, best and darkest specimens are found in northern Canada. Sir John Richardson met with it as far north as latitude 66°. The popular name of *Putorius vison* is supposed to be a corruption of Moeuk, a name given to a closely allied species in Sweden. The body is long and vermiform, the head small and oval, the neck long, and legs short, with five toes on each foot. The color of the fur, which is highly esteemed, is a uniform brown

Fig. 409. Mink (*Putorius vison*).

or tawny, with light brownish or yellow fur beneath, near the body. Some specimens are much darker than others, and there is usually a white spot under the throat, and another on the throat. The length of the head and body is about thirteen inches, and of the tail about seven inches. The mink is an expert fisher and hunter. Though largely of an aquatic habit, it yet subsists much on birds, mice, and other small animals. Fish, flesh and fowl seem alike to its taste. It has been known to catch a trout of a foot in length, while it is an expert robber of the hen-roost. Birds, mice, rats and other small animals are amongst its victims. It is no uncommon thing for a mink to rob an angler of his catch, if he leave it behind him for a time on the bank of the stream. In the southern states it feeds largely on the marsh-hen. The mink possesses but little cunning, and is easily captured in any kind of trap. It is taken in both steel and box traps, but more generally in what are called deadfalls. It is attracted by any kind of fish or flesh, and traps are baited with the head of a partridge, duck or chicken, or a piece of fish. Like the skunk and the ermine, it emits an offensive odor when provoked by men or dogs. When taken young it is easily tamed, becomes very gentle, and forms a strong attachment to those who fondle it in a state of domestication.

Ermine.- The common white weasel or stoat of Canada (*Putorius erminea*) is the true ermine, virtually the same species as that of northern Europe and Asia, which in the feudal ages yielded the fur for the choicest mantles of nobles and kings, although the Canadian-produced fur, except in the far north, is inferior to that of Europe and Asia. Smaller than the mink, but not unlike it in form, being but about ten inches long from the snout to the root of the tail, the weasel is fiercer and more bloodthirsty than *Putorius vison*, possessing an intuitive propensity, says Audubon, to destroy every animal and bird within its reach, some of which, like the American rabbit, the ruffed grouse and domestic fowl, are ten times its own size. A single ermine has been known to kill forty well-grown fowls in a single night. Notwithstanding its mis-

chievous and destructive habits, the ermine is rather, perhaps, a benefactor than an enemy to the farmer, ridding his fields and granaries of many depredators on the product of his labor, such as the white-footed mouse, the pine-mouse, the ground-squirrel, the rat and the common house mouse, which would devour ten times the value of the poultry and eggs that at long and uncertain intervals it may destroy. The skin of the little animal had become practically so valueless a few years ago that the hunters scarcely secured more than five cents each for it. Today it is worth twenty-five cents to a dollar each. Naturalists do not agree as to whether the apparent change of color from summer brown to winter white is effected by shedding the old hair, the new coat growing another shade, or whether the hair actually changes color itself.

The marten (*Mustela Americana*, Fig. 410), also called the pine-marten, and American sable, is larger than the mink, and almost always lighter in color. The body is slender, the head long and pointed, legs short and stout, eyes small and black, tail bushy and cylindrical. Its coat contains two kinds of hair, the outer long and rigid, the inner soft and somewhat woolly. The length from point of nose to root of tail is about eighteen inches. The color varies considerably in different individuals, but is generally yellowish, shaded more or less with black, the throat being yellow. The darkest skins are the most valuable. Its food consists of birds, mice, squirrels and other small animals, and it climbs trees with great facility. It is so easily caught in traps that it has been exterminated in many parts of Canada and the northern states where it was once abundant. Where the Indians have properly preserved hunting-grounds, this valuable fur-bearing animal is as carefully preserved as is the beaver. It is by no means unusual for a good marten to sell for $35. Less than twenty years ago martens could be had for $5 or $6 each.

The fisher or pekan (*Mustela Pennauti*), also known as Pennaut's marten, is a kind of marten, about the size of a small fox, of a general dark brown or nearly black color. It is sometimes known as the *blackcat*. It frequents swampy lands, preying on fish, frogs, squirrels, mice and other small animals. It is found all over the continent as far south as the Carolinas, except where it has disappeared before a dense population. It is nocturnal in its habits, will rob a line of traps of bait, like the carcajou, and has even been known to tear in pieces a pine-marten that had been caught in a trap. In the early part of the last century, when these animals were more common in the state of New York, the hunters used to get them by following their tracks in the snow, when they had been out in quest of food on the previous night. They would thus trace them to the hollow trees in which they were concealed, which the hunters chopped down. It is said that as the tree was falling, the fishers would dart from the hollow, which was often fifty feet from the ground, and leap into the snow, when the dogs usually seized and killed them, although not without a hard struggle, as they are much more dangerous to dogs and hounds than either the gray or the red fox. An ordinary specimen measures twenty-three inches from the point of the nose to the root of the tail, and weighs eight or nine pounds.

The otter (*Lutra Canadensis*) is in appearance a magnified mink. Its walk, fur and color bear strong resemblance to those of the latter animal, and the lightening of the tints of the pelage in old age is the same in both. Its fur is short and thick, the under part being of a silvery white shade, slightly waved and silky, and of similar texture to that of the beaver, but not so long. The color of the overlying hairs varies from a rich and glossy brownish black to a dark chestnut. In summer the color is a rusty brown, and the fur is shorter and thinner. Its habits are aquatic. From the shortness of its legs, its motions on shore are not so quick as when in the water, and as its food is principally fish, it resides in winter near some lake or river where it keeps a hole open in the ice all the season. During this period of the year its migrations on land in high latitudes, where the ground is covered with snow are toilsome, and it leaves a deep furrow or path in the snow, which, when seen by the trapper soon after the animal has passed, invariably leads to its destruction. If a trap be set on this road

Fig. 410. The marten (*Mustela Americana*).

the otter is almost certain to be caught, as it has a strong objection to opening new paths through the deep snow. In firing at an otter in the water, care must be taken not to shoot it in an immediately vital part, as the body sinks like a stone immediately after death.

Foxes.—In treating the different varieties of foxes, it is extremely difficult to mark the line where one ends and another begins, for every shade of color from a bright flame tint to a perfectly black pelt may occasionally be seen. *Vulpes fulvus* is the common red fox, variety *decussatus* the cross-fox, and variety *argentatus* the silver fox. The appearance of the common red fox is too well known to require description. In the cross-fox, the legs, the muzzle and the under parts are black, and the tail is blacker than that of the common red fox. A dark band runs down between the shoulders, crossed by another over the shoulders. The silver fox is entirely black except on the posterior part of the back, where the hairs are annulated with

gray, although this feature is occasionally wanting. The tail is tipped with white. Experiments having proved that the offspring of a pair of silver foxes are not always colored like their parents; there are those who contend that the silver is not a species but a freak. Whatever be its origin, it is the most valuable fur known after that of the sea-otter. As a rule, only a few score are taken each year in any district. The annual American output does not exceed a thousand. An exceptional skin has sold as high as $2,500, but the usual price is $250 to $1,000. Foxes are by no means choice about their food. Mice, birds, hares, fish, carrion, all come alike to them, and they will even make a meal of a fellow fox if one is found dead in a trap. They are killed by hunting, by snaring, by traps, by unearthing and by poisoning.


Fig. 411. Skunk (*Mephitis mephitica*).

The skunk (*Mephitis mephitica*, Fig. 411) is found throughout the Dominion of Canada as far as 57 degrees north, and ranges south to Kentucky, Carolina and Alabama. It is about the size of a large cat, has a broad, fleshy body, wider at the hips than at the shoulders, long coarse fur and short legs. The general color is blackish brown, with white longitudinal stripes on the back. It is carnivorous, its prey being small birds, eggs, insects, mice, frogs and the like, and it is particularly destructive in the poultry yard. In northern regions it hibernates in winter. Although, in self-defense, capable of emitting an odor perhaps the most offensive in nature, the skunk is an exceedingly clean animal; a dozen may sometimes be concealed in a single burrow, and yet not the slightest unpleasant smell can be detected at the entrance. The flesh is eaten by the Indians and pronounced by them superior to that of the raccoon or opossum. Its fur is very much in demand for dressing and dyeing, for the production of what is known as Alaska sable. In recent years it has become one of the most important of North American fur-bearing animals.

Bears.—Of the bear there are several American species, chief among which are the very common black bear (*Ursus Americanus*, Fig. 412), which sometimes attains a weight of 600 pounds, the grizzly (*U. horribilis*), the white or Polar bear (*U. maritimus*) and the cinnamon bear. The last-mentioned is a native of the Northwest; the grizzly is found in the Rocky mountains; the Polar bear is a native of the arctic regions, while the black bear, which is most extensively trapped for the sake of its fur for commercial purposes, inhabits all the wooded parts of North America. It has very stout legs, a somewhat bulky but flexible body, and long, soft, glossy fur. The general color is black, but it sometimes varies to brown or yellowish. Its food is principally vegetable, consisting of roots, berries, nuts, and the like, and it will even catch fish out of shallow water for food. It will devour eggs and small birds, and will carry off and devour hogs. When driven to extremities, the bear will stand on its hind-legs and make a terrible battle with its powerful paws. The bear is often shot in burnt lands and while swimming in lakes, but is more often captured in deadfalls.

The rabbit is too well known to require description [see article on *Pets*], and space will permit only brief accounts of the raccoon, the wolf and the lynx, which supply a number of skins annually in the United States and Canada.

The raccoon (*Procyon lotor*, Fig. 413) was classed by Linnæus among the bears, under the genus *Ursus*, its feet being plantigrade with naked soles. When it sits, it often brings the whole hind sole to the ground, resting in the manner of the bears, although it walks on its toes. Its body is rather stout, the legs of moderate length, its color on the upper part of the body grayish, mixed with black, the ears and under part whitish, with a black patch across the eye, and its long and bushy tail having four or five annulations of black and grey. While not intended for great speed, it is capable of a tolerably rapid race and is able to climb, and although not with the agility of the squirrel, yet with greater alacrity than its near relative, the bear. In the United States it is found as far south as Mexico. In Canada it has been taken as far north as Winnipeg.

The raccoon usually brings forth four to six young at a time. It may almost be called omnivorous. Green corn and oysters, fish and poultry, eggs and fresh-water shell-fish, honey and chestnuts are all acceptable. Like the bear, the raccoon, in northern latitudes, hibernates for some months during the winter.


Fig. 412. American or black bear (*Ursus Americanus*).

Wolf.—There are several varieties of the American wolf, all of about the same size. Sometimes they band together in the same pack, black, white, grey and red wolves being seen occasionally in the same company. The grey wolf (*Canis lupus*) is the variety most common in Canada and the northern

states. It has a thick head, long nose, erect and conical ears, and a muzzle elongated and somewhat thicker than that of the Pyrenean wolf. The general appearance of the upper surface of the animal is dark brindled gray, with an indistinct dorsal line, a little darker than the color of the sides. The under parts are of a dull white color. The wolf is a cruel, savage, cowardly animal, and very destructive of deer, which it hunts singly or in packs. All the varieties are extremely swift of foot, and it is difficult to run them down for the purpose of shooting them. They are usually either taken in traps or killed with strychnine. In winter, when there is no crust on the snow in the north for some time, sufficiently strong to carry a wolf, many of the animals perish from hunger.

The American wolf burrows and brings forth its young in earths having several outlets. The number in a litter varies from four or five to eight or nine. The skin of the wolf is used chiefly for sleigh or carriage robes and for floor mats and rugs. Rough driving coats also are sometimes made of it, although the hair on the back is three to four inches long.

Lynx.—There are two distinct varieties of the lynx in North America, the Loup Cervier or Canadian lynx (*Lynx Canadensis*, Fig. 414) and the Bay lynx or wildcat of the United States (*Lynx rufus*). This genus has been separated from the old genus *Felis* because of the tufted ears, shorter bodies and tails in proportion to their much larger bulk, and also of the slight differences in the teeth, the lynx having one tooth less on each side of the upper jaw than the tame cats. Although both of the American wildcats are found in Canada, the so-called Canada lynx is larger than *Lynx rufus*. The latter is of a yellowish or reddish brown, while the larger variety is generally grey

Fig. 413. Raccoon (*Procyon lotor*).

and clouded with irregular darker spots. Although the skin of this latter may be seen in the collections of almost every extensive fur-dealer in Canada, the animal is seldom met with in its wild state, unless by those sportsmen or others who penetrate into the more retired recesses of the forest. The settlements are not often visited by this beast of prey, for it can generally find a sufficiency of food in the woods and is not, therefore,

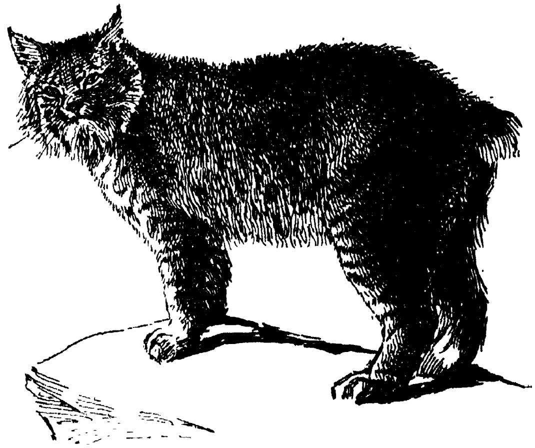

Fig. 414. Canada lynx (*Lynx Canadensis*).

very often compelled by famine to forage in the farmyard. Its prey consists largely of such small animals as the northern hare, the gray rabbit, squirrels, mice, grouse and birds of various kinds, although it is thought that the wolf is sometimes blamed for carrying off a lamb which has feasted the lynx. When it enters a place frequented by rabbits, it seldom leaves the locality until it has killed them all. From the great size of its claws and teeth, and its formidable appearance, the Canada lynx has acquired a reputation for ferocity, cunning and daring, to which it is not entitled. Although strongly built and capable of climbing trees with ease, the lynx is timid and even cowardly at the sight of man, and a very small dog will instantly put it to flight. It swims well, breeds once a year, having two young at a time, is easily taken in traps, and some of the Indians eat its flesh. When cornered by dogs it fights like a cat, spitting and striking with its sharp claws, with which it can inflict severe wounds. Its feet are completely covered with long woolly fur, so that its tracks on the snow are very large and do not show any impressions of the toes. Most of what has been said of this variety applies equally to the common American wildcat, except that the latter has never been known to attack any but animals smaller than itself.

Handling the furs.

The American furs which find their way to the great auction marts of the Old World are received and sold in their raw state, much in the same condition in which they left the hands of the trapper. Until comparatively recent times, Germany had the monopoly of the dyeing and dressing of certain furs, particularly of squirrel skins and of white furs, such as the ermine and Polar bear. Almost all Alaska seal skins are dressed and dyed in London,

not because of a lack of expert workmen in the United States, for some seal skins are skillfully manufactured in New York, but because of the favorable financial arrangements and harmonious coöperation existing in London, where the raw furs are sold, between fur-brokers, fur-dressers and bankers, whereby most of the purchase money may be withheld until the skins have been dressed and dyed, six or eight months later. In the principal cities of Canada and also in several in the United States, there are establishments for the dressing, dyeing and manufacture of native furs. The great American center of this industry is the city of New York, which leads the world as a consumer of furs, the sales to individuals there exceeding those of any other city in the world. Many firms, long established, with large capital and of international reputation, conduct the business.

Much space might be devoted to an account of the interesting processes followed in the preparation of dressed furs from the raw skins. The finest qualities of furs, with the exception of the Alaska seal, are seldom dyed. The process of dressing differs for various kinds of fur, but there are many features of the industry common to almost all of them, such as the removal of grease and dirt, the conversion of the pelt or membrane into a sort of soft and pliable leather, and a paring down of its texture. Some of these operations are necessarily very delicate ones. Very greasy skins, as those of the mink, are first of all scraped, and then, like others, are soaked in water over night for softening and opening the texture preparatory to the unhairing and leathering processes. Heavy pelts, as those of the beaver and otter, are then "beamed," for the purpose of breaking up the texture of the membrane and softening it. If the overhairs are to be removed, that process is next in order, except in the dressing of muskrat skins, when it is usually postponed until after the dressing. After plucking, heavy skins are shaved to a thin, even surface, with a "skiving" knife. Next comes the leathering. The pelt side is dampened over night with cold salt-water, and the following day, butter, or other animal fat, is rubbed on the membrane. This greasing is omitted in dressing mink or other very oily skins.

Then follows the tubbing, one of the most curious processes of the trade. In order thoroughly to soften or "leather" the pelt, a number of skins are placed in large tubs with mahogany sawdust, each tub being occupied by a workman, who for two or three hours is engaged in tramping the skins with bare feet. The skins are subsequently placed in revolving cylinders with clean sawdust, this in order to extract all the grease, which adheres to the sawdust. After this the sawdust is beaten out, and the combing of the furs completes the operation of dressing. The process is subject to many variations for different kinds of furs.

Fur-farming.

Many experiments in fur-farming have been attempted from time to time, but few, if any, have proved a success. A skunk-farm, which has been in operation for a number of years in Ontario on a small scale, has given some fair results, many of the animals having become partially tamed. Similar farms have been established on a large scale in some of the western states, but are still in the experimental stage. The proposition has been more than once made to stock Hudson bay with the Alaska seal. The conditions as to food, temperature, and the like, are declared to be favorable, and different varieties of the hair-seal thrive admirably under similar conditions. The project in question, which involved the purchase and transfer to the bay of one hundred cow seals and fifteen bulls, was submitted to the Dominion government some time ago, but nothing came of it. It may be revived later.

An extensive system of otter-farming in the swamps of Florida was seriously proposed some years ago. Beaver-farming, as attempted in a restricted area on the north of Lake Superior, proved a failure. There is no reason, however, why the introduction of beaver from the Yellowstone National Park into parts of the Adirondacks, where they were once plentiful, should not be followed by good results, if the animals are protected from molestation; for no effort has been made to confine them within unnatural limitations. It is the change from natural conditions, accompanying almost every attempt at fur-farming, that dooms it to failure. Beavers and foxes, as well as big game, liberated by Mr. Menier on his island of Anticosti, are apparently multiplying and doing well. Fur-bearing animals of all kinds, on the other hand, kept in close captivity, have deteriorated in the quality of their fur, often pining away and dying. A few silver foxes are reported to have been raised successfully in captivity by a trader on the Labrador coast, but the experiment was not repeated successfully through a second generation, and the furs were of an inferior and bedraggled character. They come to their greatest excellence, as a matter of fact, only when the animal enjoys that wide ranging of its natural state which ensures robust health.

Literature.

The literature of the fur trade is very exhaustive. On North American fur-bearing animals see: Sir John Richardson, Fauna Boreali-Americana; George Cartwright, Journal during a residence of nearly sixteen years on the coasts of Labrador; The Canadian Naturalist for 1857 and following years; H. de Puyjalon, Histoire Naturelle a l'usage des Chasseurs Canadiens, et des eleveurs d'animaux a fourrure; The Fur Seal and Other Fisheries of Alaska, published by the House of Representatives, Washington (1889); Florida Fur Farming, in the Bulletin of the United States Fish Commission (1897); various articles on the wild animals of the United States in the annual reports of the Department of Agriculture, Washington; The Seal Hunt of the Gulf, E. T. D. Chambers in East and West, Toronto, May, 1907; descriptions of the Newfoundland seal hunts in books on Newfoundland, by Judge Prowse and Rev. Moses Harvey; A. P. Low, Trail and Camp-fire. On the Indian fur-hunters, the trapping of furs and the fur industry in gen-

eral, consult histories of the Northwest and of the Hudson Bay Company; Miss Laut, Story of the Trapper, and Fur Trade of the World, in the World's Work of May, 1907; Geo. Bird Grinnell, Story of the Indian; Hind, Labrador; E. T. D. Chambers, The Montagnais Indians and Their Folklore; H. de Puyjalon, Petit Guide du Chasseur de Pelleterie; Horace T. Martin, Castorologia, or the History and Traditions of the Canadian Beaver; Charles H. Stevenson, Utilization of the Skins of Aquatic Animals, in the report of the United States Commission of Fish and Fisheries (1902).

GOAT. *Capra* spp. *Bovidæ.* Figs. 415–419.

The goat is a genus of quadrupeds, very closely allied to the sheep. It seems probable that the domestic goat is descended from the Persian pasang (*Capra ægagrus*), which is the most characteristic species of the wild goats. The types of domestic goats that have been developed under their long period of domestication are very numerous, but comparatively few are of economic value in America. Perhaps the Angora (*Capra angorensis*) is the best known in this country, although the interest in milch goats is increasing. The zoölogical origin of the Angora goat is not known. The prevailing opinion seems to be that the foundation stock is some derivative of *Capra ægagrus*, perhaps with crosses from the markhor (*C. falconeri*) or other wild Asian species. The goat has never been held in high esteem in America, but this condition may change.

Mention should be made of the Cashmere or Shawl goat of India, which is valued for its fine, silk-like under-wool, much prized in shawls. "Mountain goat" is mentioned under *Sheep*.

Angora Goat. Figs. 415, 416.

By *E. L. Shaw.*

The Angora is raised primarily for its mohair and meat. The male goat is called a buck, the female a doe, the castrated male a wether, and the young a kid.

Description.

The Angora goat was formerly described as a small animal, but, owing to favorable conditions, its size has been greatly increased. It is smaller than the common goat, weighing sixty to one hundred pounds, although specimens are frequently found that weigh considerably more. Both males and females have horns and beards, but in rare instances an animal without horns may be seen. The horns of the male grow to a length of fifteen to twenty inches and turn upward and outward with a backward twist, while those of the female, which grow to a length of eight to ten inches, grow upward and point backward, with only a slight inclination to twist. The horns are grayish in color, never black. The body should be round, the back straight, with shoulders and hips of equal height. The chest should be broad; legs short and strong; head broad, with a wide muzzle and bright eyes; ears either partially upright or distinctly pendent, and six to eight inches long. The fleece should be pure white, covering all parts of the body, as dense on the belly and neck as on the back and sides, and it should extend to the ears and the jaw. Many Angoras have mohair on the forehead, face and legs. The mohair should make an annual growth of not less than eight to ten inches, and weigh three to five pounds per fleece. It should hang in well-formed

Fig. 415. Angora goats.

ringlets from all parts of the body, and should be fine, soft, lustrous and strong. The fleece should be free from kemp. The fibers become coarser, thinner and straighter as the animal grows older. The best mohair grows on goats of the best blood; and among these, that on the kids, yearling wethers and does is superior in the order named.

The offensive odor from the bucks of the common goat is entirely absent in the Angora breed, except at the rutting season, and then it is noticeable only in a slight degree. The odor in a fleece of mohair is milder than that in a fleece of wool.

History.

The Angora goat derives its name from the vilayet of Angora, in Asia Minor. The city of Angora is the capital of the vilayet of Angora, and is located about two hundred miles south-by-southeast from Constantinople. The province is mountainous to a considerable extent and furrowed by deep valleys. The climate is extreme. Some writers have ventured to say that the Angora goat originated in this district over 2,400 years ago.

It is said that the pure Angora goat was nearly bred out in 1863. The reason for this was the extensive crossing with the common Kurd goat.

In America.—The first importation of Angora goats to America was made in 1849. During the administration of President Polk, says Colonel Richard Peters, the Sultan of Turkey requested that a suitable person be sent to that country to conduct some experiments in the culture of cotton. Dr. James B. Davis, of South Carolina, was delegated. On his return to the United States in 1849, the Sultan presented to him nine choice Angoras. These animals were imported as Cashmeres, and were so regarded until after they were purchased by Colonel Richard Peters in 1853. This importation was frequently exhibited at fairs, and always

attracted much attention. Colonel Peters is generally regarded as the real founder of the Angora goat industry in America.

There have been, from time to time, various other importations of Angoras from Turkey and South Africa. These are widely disseminated, and the blood of most of them has been beneficial to the industry in this country. The Civil war was disastrous in its effects on the industry, and the Angora goats in the southern and eastern sections of the country were practically exterminated. The western men who adopted the industry, and finally saved it, were William M. Landrum, C. P. Bailey and John S. Harris.

Distribution.

Angora goats are widely distributed throughout America. They are found in almost every state and territory in the Union, the largest numbers being in Texas, New Mexico, California, Arizona, Oregon and Montana. They are found in large numbers in Cape Colony. The census report for April, 1904, gives the number in Cape Colony as 2,775,927. It is estimated that in 1894, there were over 1,230,000 Angoras in Asia Minor. [See page 409.]

Types.

Some strains of Angoras have fox-like ears, but those with the pendent ears are preferred. In this country, care must always be exercised to cull the off-colored kids from the flock. These may be the result of atavism, from a cross made on a common goat, either red or black. It is reported that different colors are found in the province of Angora among what were supposed to be pure-bred animals. Some Angoras have very little or no mohair on the forehead and legs, while others have a tuft on the forehead, and the legs are well covered down to the feet.

Breeding.

Goats of both sexes will sometimes breed when they are five or six months old, but from the fact that at this age they are but a month or two from weaning time, and are not fully grown, it is obvious that they should not be permitted to breed. They reach maturity when about sixteen or eighteen months old, and they should not be bred before this time. If bred earlier, the kids will not be so strong, nor so well developed. The goats are in their prime when two to six years old. Does should not be kept until they are very old, unless they produce kids of exceptional merit, for their mohair becomes coarser and less valuable as they mature. The average life of goats is about twelve years.

Bucks usually come in heat about the middle of July, and continue so about six months. Does do not usually come in heat until the latter part of August or the first of September. The period of gestation is 147 to 155 days. The kids should not come before the warm days of spring, or when vegetation begins to put out vigorously. The only objection to early kidding is the extra care required to preserve the life of the kids, for they are delicate for the first few days.

A buck should be in the best possible condition when put to service, and should be fed some grain during the breeding season. For the best results, about forty or fifty does should be allowed to a buck. The pure-bred Angora does not often drop more than one kid at a time, while the common goat nearly always drops two. The kidding season is the most important in the life of the goats. For several days after the kids are dropped, they naturally demand good care. After a few weeks they are able to care for themselves, and can follow the flock.

A few days before a doe is due to kid, she should be separated from the flock. Some breeders would put her alone in a pen, while others would put as many as twenty in one pen. If the facilities are at hand, a small pen for each doe is better, for the reason that the doe will own the kid sooner, and there will be less danger of injury. If kids are dropped on the range or in the pasture, they must be carried home and special care given to see that the does are made to own them, for many times they will refuse, especially if they have no milk.

There are in use two methods of handling the does and kids at kidding time, namely, the corral method and the staking method. Each of these methods has its advantages.

(1) The corral method may be used with any number of goats. When a large number of does are expected to kid, it is necessary to have one or two large corrals and several smaller ones. The does expected to kid, or those that have kidded, are put in the small corrals, and after a day or so are removed to one of the larger ones. This procedure is repeated until all the does have kidded.

(2) The other, the Mexican or "staking method," is used largely in Texas and New Mexico. When a kid is born, it is taken to a convenient place to "stake" and the mother is coaxed to follow, and the kid is "staked" or "toggled" with a string about twelve inches long. This string is tied to one leg, being changed occasionally from one leg to another to avoid lameness. The string should have a swivel in it to prevent twisting. Kids are usually staked for a week to ten days.

Kids should not be weaned until they are about four months old. The buck kids, not intended for breeding purposes, should be castrated when about two weeks old. The earlier it is done, the better will be the meat and mohair.

No amount of cold will prove injurious to goats if they are kept dry. A shed of easy access is one of the essentials of goat-raising. Angoras are able to withstand both extreme heat and extreme cold if proper shelter and feed be provided. They require a large amount of fresh air and exercise.

Feeding.

The browsing habit of goats is an important factor in their feeding. In some sections, they secure browse all through the winter season, as in the Southwest, where there is an abundance of live-oak. Corn fodder, cowpea hay, clover hay, and alfalfa are all excellent coarse feeds. Oats, corn and bran are valuable winter rations. Goats require more

salt than do sheep, owing to the more astringent character of their feed. A running stream in a pasture is valuable, but if it is not present, good, fresh water should be supplied.

Marking.

Several devices for marking goats are in use, but the metal tag in the ear is probably best known. A practice which appears to give satisfaction is to tattoo the numbers into the ear, using indelible ink. It is found that the metal is sometimes pulled out by brush.

Shearing.

In Texas, New Mexico, Arizona, and sometimes in California, shearing is done twice a year, usually in the months of March and April, and in September or October. The reason for this practice is that, owing to the warm climate, the fleece will often shed in the fall if not clipped. In other parts of the country, shearing is done but once a year, and that in the months of March, April and May. The shearing machines, largely employed among sheep-raisers, are coming into general use among goat-breeders.

Goats are not so gentle in the hands of the shearer as sheep, and many men, especially among beginners in the industry, desire to know how best to handle them during the operation of shearing. For this purpose, a simple combination trough and table (Fig. 416) was devised by F. W. Ludlow, of Lake Valley, New Mexico. This table is first used in the shape of a trough. The goat is placed in it on its back and held down by means of a strap across its throat. While in this position all the underparts, sides and legs may be worked on. In machine shearing, it is a good practice to start at the brisket and shear all the belly as far back as possible ; then shear the front legs and neck ; then start at the hocks and shear up the hind-legs and along the sides to the point of beginning. After shearing one of the sides allowed by the trough, the goat is tied — "hog tied," to use a western expression —that is, all four feet are tied together. The sides of the trough are now dropped, forming a table on which to finish the operation. There is now free access from the tail to the head, and the goat remains helpless. The proper course is to leave all the fleece on the table until the goat is liberated, and then roll it up inside out.

Mr. Ludlow's description of this table is given herewith : "The table is simple in construction. It is about 22 inches high, 2 feet 10 inches long, and 21 inches wide. The top is composed of two 9-inch sides, which are hinged to the 3-inch centerpiece. On the lower side of these movable flaps is a narrow piece 8 inches long, which catches on the framework of the table when the sides are lifted and holds them stationary. When the sides are elevated, the top of the table forms a trough 3 inches wide at the bottom and possibly a foot wide at the top. Into this trough the goat to be shorn is thrown, feet up. A small strap, which hangs from the end of one of the sides, is run over the goat's neck and fastened to the other side. The goat's head is hanging over the end of the table and the strap prevents it getting free. The belly and legs are then shorn. The legs of the goat are then tied together, the strap removed from the neck, and the sides of the table dropped, so that one has a plane surface on which to shear the rest of the animal. An untrained man can shear 100 goats a day with a shearing machine and such a table."

Few breeders wash their goats before shearing, and if the animal has been properly cared for during the winter and early spring, washing is not necessary. Breeders find it to their advantage to ship the mohair in as clean a condition as possible. Colored fleeces, tag locks, mohair that is clotted and that which is dirty, should be packed separately. As kid hair is usually the finest, it should be packed by itself ; the doe hair and that from the wethers may be placed together. Fleeces should not be tied

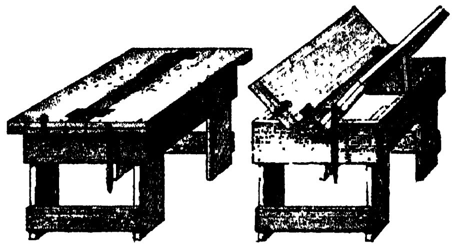

Fig. 416. A shearing trough and table combined.

with twine, as parts of it are likely to adhere to the fleece, and can be removed only by great care and effort. Fleeces from Turkey and Cape Colony are not tied at all, but are simply rolled up inside out ; this is the condition in which the mills desire to receive them.

Uses.

The Angora goat is considered one of the most useful of the domestic animals, and has been so held from remote times. This usefulness is manifested in many ways.

The mohair.—The fleece, called "mohair," is used extensively in the manufacture of plushes. It is not generally known that practically all of the plushes used in railway passenger coaches and street cars are made of mohair. Besides these plushes, which are usually plain, large quantities of frieze and crush plushes are used in upholstering furniture. The designs for the frieze plushes are limited only by the ingenuity of man. The carriage robes, couch covers, sofa-pillow covers, and rugs are distinguished by their high pile and rich coloring. Most of the so-called astrachan now in use is made of mohair.

Besides plushes, which form the principal item, there may be mentioned dress goods of various designs, coats and coat-linings, table covers, knit mits, mittens and gloves, made from mohair.

In addition to the mohair, there grows on the Angora goat coarse, chalky white, stiff, straight hair, varying in length from half an inch to four inches, technically known as "kemp." It is generally thought that kemp is a relic of the common goat blood in the Angora, as it is a matter of his-

tory that the Angora flocks of America, as well as those of Asia Minor and South Africa, have been largely increased by crossing does of common blood. It is objectionable.

The skins.—The skins of the Angoras, if taken when the hair is about four inches long, make very handsome rugs. The hair retain its original luster, and may be used in the natural white, or dyed any color desired. Carriage-robes are frequently manufactured from the skins. The smaller skins of the does, wethers and kids find a use as robes for baby-carriages, and are extremely attractive. The skins are also used in the manufacture of children's muffs, and as trimmings for coats and capes. The finest kid fleeces adorn the collar and border of some of the ladies' opera cloaks.

To clear brush land.—Goats are browsers by nature, and there is no vegetation they will eat in preference to leaves and twigs of bushes. The Angora has been used in many parts of the country for clearing land covered with brushwood. In localities where valuable land is completely overgrown with brushwood, the goats are considered of more value for clearing it than for their mohair or meat.

The milk.—The Angora is not primarily a milch goat, and is not often employed for that purpose. Information at hand shows that the quantity of milk given by an Angora doe is uncertain, and in exceptional cases only does it approach in quantity that produced by the established breeds of milch goats, such as the Toggenburg, Saanen, Maltese and Nubian.

The meat.—The flesh of Angora goats is exceedingly nutritious and palatable. When properly fattened, they produce a meat so nearly like the best lamb that it takes an expert to detect the difference. A large number of Angoras are slaughtered annually in Texas, Arizona, New Mexico and California. In Cape Colony, it is said that old does are slaughtered to furnish meat for farm hands, and young wethers are sold to butchers in the towns.

Kansas City is the leading goat market, over sixty thousand head having been sold in this one market in 1907.

Protection for sheep.—There is very little complaint heard from breeders of Angora goats concerning the ravages of dogs. Bucks can be trained to fight dogs and thus be a protection to sheep. A few goats will stay with a flock of sheep, but if there are many of them they will be likely to separate.

Pets.—As pets for children, Angora goats are popular. They are remarkably intelligent and are easily trained. They are often harnessed to carts.

Organizations and records.

The American Angora Goat Breeders' Association, organized in 1900, maintains the only record of pure-bred Angora goats in America. This organization has a membership of over five hundred breeders, representing nearly every state and territory in the Union. Over sixty-five thousand animals are recorded in the Angora Goat Record.

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Milch Goats. *Capra hircus*, Linn. Figs. 417–419.

By *William C. Clos.*

The breeding of goats for the production of milk is a growing industry in some parts of America. In the development of the dairy type, numerous breeds and varieties of goats have been produced, adapted to meet different conditions.

Description.

According to the best authorities, the following general points and qualities are applicable to all types of milch goats. They must possess good forms, indicating constitutional strength and high productiveness. The head must be light (dry), eyes fresh and lively, horns (in all horned breeds) small, neck broad, breast wide, ribs well sprung, back long and straight, hips broad and strong, legs sinewy and straight. Healthy claws, a fine, thin skin and a well-developed, but not too pendent udder and good teeth are also necessary requisites.

History.

Goats are among the oldest domestic animals, and have contributed their share to the subsistence of mankind as far back as historic evidences reach. Rutimeier discovered their remains among the ruined piles of the ancient lake-dwellers in Switzerland. Goats and their products are mentioned frequently in the Bible, and by Herodotus and Homer, and have maintained their popularity, especially among oriental nations, to this day.

The question of their origin is still in dispute. According to Julmy, a majority of zoölogists maintain that the European goat is descended from the Persian pasang or Bezoar goat (*Capra œgagrus*), while others seem to trace it to the Alpine ibex (*Capra ibex*).

Whatever may have been their origin, they have exerted a strong influence on the economic welfare of the peoples among whom they have been found. Their growth in numbers, outside of America, has been noteworthy; and in this country their popularity may be said to be increasing. The following

statistics indicate their popularity. G. F. Thompson states, in his "Information Concerning Common Goats," published in 1903, that there were 1,871,-252 goats of all kinds kept on farms in the United States, as reported in the census for 1900, representing a total value of $3,266,080. Besides these, there were 78,353 goats reported for cities and villages, which would bring the total up to 1,949,605 head. He estimates the number of Angoras at 700,000, and the remainder, he says, "are all sorts of animals except recognized breeds of milch goats, of which there are so few as not to affect the total materially." This is indeed a small number, but it indicates the need as well as the possibilities of improvement.

European statistics give far more satisfactory results. Germany had (in 1883), according to Dettweiler, 2,639,904 milch goats; Switzerland (in 1896) possessed 416,323 head (Stebler). Pegler, in his work (The Book of the Goat), gives the following figures: France, 1,794,887; Russia, 1,700,000, Austria, 979,104; Spain, 4,531,228; Italy, 1,690,-478, and the grand total for continental Europe as 17,198,587 head. The Yearbook of the United States Department of Agriculture for 1906, in its statistical columns, gives the total number of goats for South American countries as 5,662,239; North and Central America, 6,296,192; Africa, 17,557,-590; Asia, 40,557,402, while Australia (total Oceanica) is marked down to a total of only 114,-865 head.

In America.—As has been said, little effort has been put forth to improve the common goat of America, and no important milking strains or families have been produced. It is only under the stimulus of recent importations of some of the best European types that interest in goats for milk-production has sprung up. The first importation was that of W. A. Shafor, of Ohio, who brought over four Toggenburg goats in 1893. The next important importation was made by F. S. Peer, of Ithaca, New York, in the spring of 1904, when he brought over a large number of Toggenburg and White Saanen goats for individuals in Massachusetts, New York, New Jersey and Maryland. In 1905, the United States Department of Agriculture became interested, and through G. F. Thompson imported sixty-eight maltese goats for experimentation in America. The results of this experiment were not satisfactory.

Distribution.

At the present time goats are distributed over a large part of the globe, but it is to be regretted that statistics furnish but very meager information in regard to their dissemination. Such statistics as are available indicate that they are found in larger or smaller numbers in nearly every inhabited land. In America they are widely scattered. An idea of their geographic distribution will be gained by reference to the statistics given above.

Breeds and types.

Following are brief notes on the most prominent breeds and types.

The Nubian milch goat is a long-legged goat, with generally a polled head, sunken nostrils, projecting lower jaw, long, hanging ears in most specimens, large, well-shaped udder and teats. The color is brown or black. The hair varies in length. It is native in Nubia, northern Egypt and Abyssinia. Huart du Plessis and Pegler recommend this breed very highly because of its large size and unsurpassed milking qualities, giving four to twelve quarts per day. However, it is very sensitive to cold and for that reason is not adapted for northern climates. Its ameliorative value, however, is not to be lost sight of in cross-breeding experiments, especially with southern varieties, as the New Mexican.

The Maltese goat.—According to Thompson, this type is about two feet and six inches in height and will often weigh 100 pounds. It is usually hornless, and the predominating color is white, although there are many other colors, as red, brown and black. The ears are moderately long and horizontal. The body is low and stocky. It is said that the milking quality of the breed has been so perfectly developed that

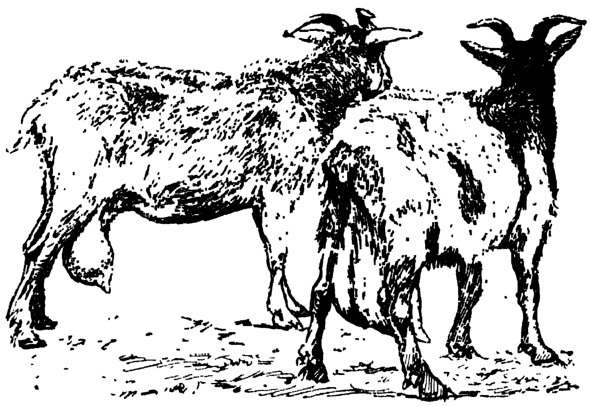

Fig. 417. Milch goats, with udders too pendant. Owned by J. F. Zion, Phoenix, Arizona.

nearly every doe kid becomes a good milker. The udder is large and is carried low, and yields two to four quarts of milk daily. In Malta it is asserted that Maltese goats never do well when exported.

The New Mexican goat.—By this somewhat arbitrary name is distinguished the only real American breed of goats known. They are common in New Mexico, Texas and the Southwest, where large numbers of them are kept by the Spanish-speaking populace. They are not uniform in color and size, but have the reputation of being fairly good milkers.

The Spanish-Maltese goat.—B. H. Van Raub, of Van Raub, Texas, is the most prominent breeder of this type, and his efforts in improving and developing this variety are said to have given to the United States the first pure-blooded breed of milch goats of its own. Mr. Thompson indicates that these Spanish-Maltese represent several varieties.

The Toggenburg milch goats (Fig. 418) are one of the oldest and best known of the numerous breeds of milch goats in Switzerland. They are hardy and

hornless, and their slender bodies are covered with silky hair of a peculiar brown color that varies much in length. The males carry a heavy, coarse beard. The legs and ears are white, the latter of medium length and well carried. The breed is further distinguished by two white stripes on their heads, running parallel on each side of the face from the

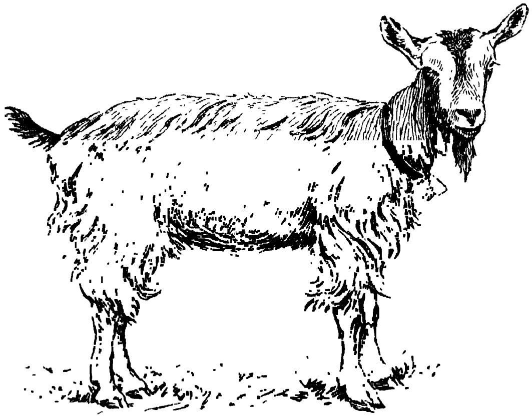

Fig. 418. Toggenburg milch goat.

ears to the mouth, and also by two peculiar small cartilaginous appendages or "wattles" on the side of the neck, called zoetteli. These "wattles" are not peculiar to Toggenburgs, but are found in nearly all breeds of goats. They are very common in Maltese breeds. They are splendid milkers, yielding four to six quarts daily, and carry the well-developed udders rather high. They bear confinement well, a fact that should not be underestimated in considering this breed.

The White Appenzeller goat may be regarded as a white variety of the Toggenburg breed, and is native in the Toggenburg valley in Switzerland. Like the latter, it is large, hardy and productive.

The White Saanen goat (Fig. 419) is another very popular Swiss breed. It is generally hornless and of large size. It is a good milker, and has been exported extensively from Switzerland for ameliorative purposes.

The Black-necked Valaisan goat is a very pretty and attractive variety covered with long, silky hair, black on the head, neck, breast and front legs, and snow-white on the entire middle and rear parts of the body. It is a fairly good milker, has a splendid constitution, but does not thrive under continuous confinement.

Management and feeding.

Milch goats are very prolific, much more so than Angoras or sheep. They usually drop twins and often triplets, and as their period of gestation is only about five months, they increase very rapidly, because they will breed shortly after kidding, and yearling does are fit for reproduction. Bucks should be chosen carefully; only those descended from good milking dams should be used, and then only when they are of good form and constitutional vigor. Because of their repulsive smell, bucks should be kept entirely separate, and as far away from the does as possible.

Milk from rutting does should not be used for domestic purposes. Observance of this rule will effectually prevent the complaints that goat's milk has a bad taste. Breeding should be so managed that does will kid three times within two years, and if several animals are kept, their lactation periods may be easily arranged so as to provide a steady and even supply of milk for their owners. The lactation period is about five or six months in the milking families.

Cleanliness is absolutely necessary when goats are confined in stables. These animals are sensitive to cold and damp and therefore should be kept in warm but light stables, with always dry bedding. They like variety in their feed, and this peculiarity should not be overlooked. They should be given clean, sweet hay, and the good vegetable trimmings from the kitchen. A handful of oats or a little bran is a very good addition to the ration, especially during the period of heavy lactation. They must have salt regularly, and as much clean water as they will drink. In the winter they should have provided for them occasionally, if possible, some hazel-brush, birch, maple, box-elder, or similar twigs. They like to nibble such things and will pay for the trouble. Willow, oak, or any other bitter or acid barks should not be used for this purpose, because they impart unpleasant tastes to the milk. In the summer a good pasture having a variety of forage and fresh water is a splendid place for them. If these directions are observed, goats will give good wholesome milk plentifully. If the milk has an uncommon flavor, the cause is usually in the feed, unless the animals are sick.

If pasturage is not available, then they should be let out into a clean yard daily, for they must have exercise, as in their natural environments they like to romp and play. Fences must be tight, otherwise

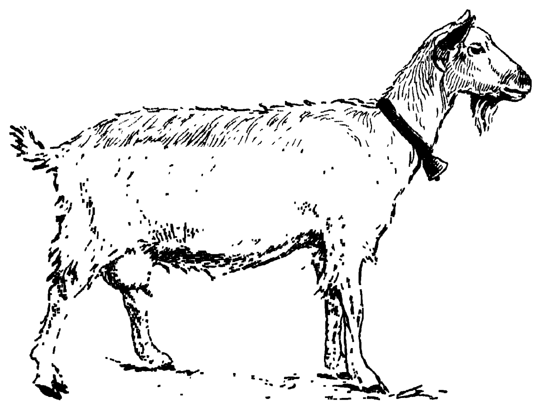

Fig. 419. White Saanen goat.

the goats will get out even in places where it would seem almost impossible for them to crawl. All braces should be on the outside, and no boards should be allowed to lean against the fence, otherwise the goats will climb over. Breechy goats should be provided with so-called "puzzles" or frames.

Kids should be separated from their mothers and fed from a nursing-bottle, because their mother's teats are usually too large for them. They should be weaned gradually, and, when they are accustomed to eat well, they will readily take care of themselves, as long as they have plenty before them to eat. Young bucks that are not needed as reproducers should be castrated early and butchered when a few months old. Their meat is then even more of a delicacy than lamb.

Uses.

Contrary to common opinion, goats have decided virtues and capabilities that will eventually gain for them a prominent place in the estimation of the people, especially among the working classes in the suburbs of large cities, and it is not at all improbable that they may win favor even with the rich.

For milk.—The principal value of the milch goat is its eminent milk-producing quality. While it has thus far been of relative unimportance in this country for its milk, this is not true in many other lands. In Switzerland, milch goats are commonly called the "poor man's cows," and well they may, as they take the place of cows not only because of their cheapness and the comparatively low cost of their keep, but also because they enable poor persons to enjoy the advantages usually derived by the better situated classes from their cattle, under conditions absolutely prohibitive to the successful maintenance of milch cows. In that mountainous land, three or four well-kept milch goats of good breeding are commonly rated equal in milk-producing qualities to an average cow, and six to eight goats may be kept on the quantity of feed required for one cow. It should also be borne in mind that two or three goats properly managed will provide a steady supply of milk the year round, while the single cow does not. Goats also are not nearly so susceptible to the diseases that have proved to be such dangerous enemies to mankind, from the fact that they can be transmitted by cow's milk. It is generally held that goat's milk is much more wholesome than cow's milk. Goat's milk may be used fresh or cooked, just as cow's milk, and is recommended as preferable for infants and invalids by the best medical authorities. Milch goats are most productive at four to eight years of age, and may live to be twelve or more years old.

Dr. Kohlschmidt's experiments on the milk-yield of goats, conducted with twenty-four animals in Saxony, demonstrated an average yearly quantity of 725.7 litres per head. The highest yield ascertained by him was 1,077.5 litres; the lowest, 612.37 litres; the average per cent of butter-fat obtained was 3.43 per cent (maximum 4.41 per cent). Huart du Plessis cites the example of a pure-bred Nubian goat giving an average of 4.5 litres per day, with 8.5 per cent butter-fat. This author estimates the capacity of a good milch goat at two litres per day for 270 days each year. Professor Anderegg says that there are four breeds of Swiss goats capable of a daily yield of four litres per head. Stebler states, on the authority of a Swiss farmer, that the total yearly expense for keeping a common goat, exclusive of summer pasturage, is a trifle over $2 in American money, against a yearly income of above $5, or a profit of over $3 per year on an investment of about $7.

For butter.—Butter may be made from goat's milk, but, owing to the irregular size of the fat globules, the cream is very slow to rise. The milk should be carefully and very slowly heated on the back of a stove until a wrinkled scum forms, and then be removed to the pantry for further rising. The longer time it takes to heat, the more cream is secured. In churning, coloring must be added, or else the product will be as white as lard, owing to the whiteness of the milk. Perfect cleanliness and special care are necessary or the butter will develop a bitter taste.

For cheese.—Goat's milk makes most excellent cheese, as all who have ever been treated to "tome de chèvre" or "Geisskaes" in Europe will admit. The milk of goats is an ingredient that enters largely into the manufacture of very expensive kinds of cheese, as the famous Roquefort, Mont d' Or, Levroux, Sassenage and others. Goat cheese has the disadvantage that it will usually not keep well unless extra care and pains are taken in its manufacture and cure. For ordinary use, however, the process is as simple as that employed in the making of any common home-made curd cheese.

For meat.—As their name indicates, milch goats are not intended as meat-producers. The flesh of older animals, therefore, is of minor quality, although capable of great improvement by proper fattening. The flesh of well-fattened older goats may be rendered very toothsome by smoking and drying. Kid meat is esteemed as a popular delicacy in Europe and elsewhere.

For skins.—The skins of milch goats are important articles of commerce, furnishing, as they do, the raw material for the finest leather (kid, morocco, saffian, and the like). At present, most of the hides used for this purpose are imported. This may very readily be made an important source of income wherever goats are kept in numbers. It is a means of profit that has been underestimated in this country.

Organizations and records.

In November, 1903, The American Milk Goat Record Association was organized to care for the interests of milch goats in America, and to promote the importation of good types. A registry is maintained, entrance being based on milk-production and satisfactory ancestry and individual qualities.

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HARE, BELGIAN. *Lepus* spp. *Leporidæ.* Fig. 420.

By *U. G. Conover.*

In America the names hare and rabbit are used somewhat indiscriminately for various species of rodents of the family Leporidæ. Hare is the generic term, while rabbit is applied properly to a short-legged species of essentially burrowing habits, whose naked, blind and helpless young are nurtured in underground nests. The so-called Belgian hare is not a hare at all, but is a true rabbit. It derives its name from the fact that breeders imitate closely the shape and habit of the hare. From an economic standpoint, the Belgian hare is the most important of the rabbit family, as it has become very popular with the fanciers, as well as with utility breeders who raise it principally for meat purposes. It is thoroughly domesticated, responds quickly to kind treatment, and is a very profitable animal to the raiser. [Other species and varieties of rabbits are discussed under *Pets.*]

Description.

The body of the Belgian hare is long and slim. The fore-feet and legs are small, the hind-feet and legs large and powerful. These characteristics, together with the long head and fine ears, give the Belgian hare a very racy appearance. The color is described as "rufus-red," and is rather a fox-color or deep golden tan. It is not distributed equally, but is richest on the shoulders and top of the neck. The hair is tipped with black, which is called ticking. The proper distribution of ticking adds greatly to the beauty of the animal. It should be confined largely to the back and flanks. The weight of the standard-bred Belgian hare is about eight pounds. There is the so-called heavy-weight Belgian, which is of a much grayer color, and often attains a weight as great as sixteen pounds. This heavy-weight type is supposed to have been crossed with the Flemish Giant rabbit, which is of a dark gray color and weighs as much as eighteen pounds. [See *Pets.*]

The following American standard of excellence for the Belgian hare shows what is desired :

	Perfect Score
1. **Color.**—Rich rufus-red (not dark, smudgy color), carried well down sides and hind-quarters, and as little white under the jaws as possible	20
2. **Ticking.**—Rather wavy appearance and plentiful on body	15
3. **Shape.**—Body long, thin, well tucked-up flank and well ribbed up; back slightly arched; loins well rounded, not choppy; head rather lengthy; muscular chest; tail straight, not screwed; and altogether of a racy appearance	20
4. **Ears.**—About five inches, thin, well laced up on tips, and as far down outside edges as possible; good color inside and outside, and well set on	10
5. **Eyes.**—Hazel color, large, round, bright and bold	10
6. **Legs and feet.**—Fore-feet and legs long, straight, slender, well colored and free from white bars; hind-feet as well colored as possible	10
7. **Size.**—About eight pounds	5
8. **Condition.**—Not fat, but flesh firm as that of a race horse, and good quality of fur	5
Without dewlap	5
Perfection	100

Disqualifications.—(1) Lopped or fallen ear; (2) white front feet or white bar or bars on same; (3) decidedly wry front feet; (4) wry tail. A specimen should have the benefit of any doubt.

SCALE OF POINTS FOR THE BELGIAN HARE

	Perfect Score
1. Stray hairs	4
2. Color of body	4
3. Color of sides	4
4. Color of hind-quarters	4
5. Color of jaws	4
6. Ticking	15
7. Symmetry of body	4
8. Symmetry of flank and rib	4
9. Symmetry of back	4
10. Symmetry of loins	4
11. Symmetry of head	4
12. Lacing of ears	2
13. Size of ears	2
14. Shape of ears	2
15. Color of ears	2
16. Quality of ears	2
17. Size of eyes	2½
18. Shape of eyes	2½
19. Color of eyes	2½
20. Quality of eyes	2½
21. Size of fore-legs and feet	2
22. Shape of fore-legs and feet	2
23. Color of fore-legs and feet	2
24. Quality of fore-legs and feet	2
25. Color of hind-feet	2
26. Size of specimen	5
27. Condition of flesh	2½
28. Condition of fur	2½
29. Shape of neck	5
Perfection	100

History.

The Belgian hare is said to have originated in Belgium, probably about the beginning of the nineteenth century, where it is now found, small in size, but perfect in form, color and markings. The modern Belgian hare, an animal of singular charm and great utility, combining the beauty and toothsomeness of the old domestic hare with the grace and fecundity of the wild rabbit, is the result of a process of breeding that has been practiced

for the past fifty years or more. Belgian hares were introduced into England about 1850. When they first came into England, there was no recognized standard to which to breed, and there soon came to be two classes of breeders, one class trying to produce size for meat stock, with little regard to other points, and the other breeding for points according to their own ideas as to what constituted an ideal animal. About 1882, the differences became so great between the two classes of breeders that it became necessary for them to get together and devise and adopt a standard for their guidance. The first standard required the animal to be somewhat racy in appearance and evenly ticked from toe to tail. The lacing was a dense black block on the outside of the ear near the point. In 1889, the standard was revised, and the new standard confined the lacing to near the edge of the ear, discarded the ticking from the breast, ears, shoulders and front feet, and required a very racy appearance.

In America.—The Belgian hare was introduced into this country probably early in 1860, but its merits were then little known, as it was by no means the perfect animal that we find in the hutches of American breeders and fanciers today. It is only in the past few years that its value as a fur- and meat-producing animal has become generally known, and in this short time it has made for itself such a record in this respect that the raising of Belgian hares for the market and for the fancy is recognized today as a distinct industry. There is demand by good hotels for the hares.

Distribution.

The Belgian hare is raised in many parts of the United States and Canada, as well as in Belgium, England, Germany and Mexico.

Breeding.

Belgian hares will usually breed at the age of six months, but this is not advisable. When they are bred so young, their offsping, as a rule, will not be so large and strong as when one waits until the doe is about eight months old before breeding. The buck should be at least eight months old, and if he is good he can be used for two or three years.

Every stud buck is able to serve a dozen does if the services are not too close together. Every breeder should keep two stud bucks, so as to furnish stock not related. Some authorities assert that an old buck and a young doe beget the largest and best young. It should be remembered that the buck is half of the herd or flock, and no one should try to get along with a poor one. In breeding, we look to the doe for size and shape and to the buck for color. From a good doe, properly mated, one will be certain to get good youngsters.

The doe should always be put in the buck's hutch, and not vice versa. If she is not in heat she will make a plaintive little noise and run from him. After waiting a few moments, remove the doe to her own hutch if she is still unwilling, and try her again the next day, and so on until she is served. Better results follow one good service than several. When the doe is bred, she should be placed in the hutch where she is expected to raise her family. The little ones may be expected in thirty days from date of service. A nest-box should be placed in the remotest corner of the hutch, in as secluded a spot as possible. This box can be about eighteen inches long by twelve inches high, with a cover so that the top can be removed and the youngsters examined after the doe has littered; and should any dead ones be found they should be removed and the rest disturbed as little as possible. After kindling, and for that matter all through pregnancy, the doe should be kept as quiet as possible.

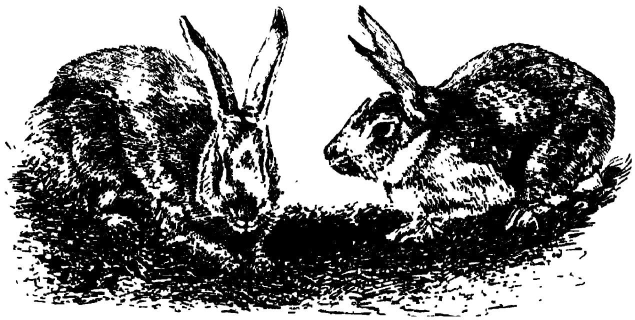

Fig. 420. Belgian hares.

As the period of gestation is only thirty days, and with an early return of the sexual passion in the rabbit family, many breeders are led to breed their does too frequently. In order to secure the best results, the writer would not advise breeding the does until the young are two months old, and in this way raise four litters a year and keep the doe in good shape. Too frequent breeding will have a tendency to impoverish the doe, thereby causing the young to lack vigor and strength, which otherwise she would have been able to give them.

A doe supporting a large litter of young, must give forth a large amount of the food she consumes to her young, and it seems almost impossible that a doe can support a litter of a dozen young and make them all grow as fast as they do. Belgian hares will double in size in a very short time, and this rapid growth continues until they are six to seven months old, when they grow less rapidly. They mature in ten to twelve months.

Fecundity. In point of fecundity, no other domestic animal can compete with Belgian hares. One doe and her offspring, if allowed to breed at will, may raise in one year about one-hundred and thirty-six. To allow them to breed at will is not advisable, but this serves to show that they are very prolific and may be very profitable.

Caring for the young.—Many persons who are not acquainted with Belgian hares, may think that the care of the young is difficult, perhaps. This is not so. The mother doe takes nearly all the care of the young, so that very little responsibility rests on the owner. All that is needed is to give the doe an extra allowance of feed, for she will eat con-

siderable more at that time; and her food should be of a milk-producing kind, so that she will provide plenty of nourishment for her young. If it can be afforded, feed the young as soon as they come out of the nest-box; bread and milk (not sloppy) and other food, such as oats and clover-hay, should be given at the same time.

The little ones make their appearance about three weeks after birth, and are very timid at first. When they are six weeks or two months old, they should be weaned from their mother. After a few days rest the doe can be bred again. The mortality among hares is very slight.

Feeding and care.

This is an important part of raising the Belgian hare, and on this, together with housing and breeding, hinge most of the successes and failures of the Belgian-hare business. Belgian hares should be fed just as regularly as the best horse or cow, with the exception that two meals be given instead of three. This gives the hares ample time to digest their food, and, if in good condition, they will be hungry and ready for each meal if they are not over-fed. The attendant should never give more grain than they will eat up clean within a half hour after feeding. When feeding clover hay, enough can be put in to last a couple of days. It is best to feed about the same hour morning and evening.

Hares eat anything that sheep will. In the summer one can feed many different things in green food, such as clover hay, corn blades, sorghum, together with most kinds of weeds that grow except the poisonous ones. In grains, one may choose from oats, corn, wheat and rye; in vegetables, either cabbage, carrots, parsnips, turnips, or potatoes. A variety of food is relished by them both winter and summer, but their main food should be clover hay nicely cured, and good sweet oats that have not become musty or damaged in any way. Hares are rather dainty eaters, and they desire everything clean. In fact, their eating is almost identical with that of a sheep. For the winter, it is well to provide for them in advance with regard to the vegetables it is expected to feed. Winter turnips can be raised after the early potatoes have been dug, or a small plot of stock-beets can be planted in the spring. The turnips or beets with the regular grain-feed make an ideal ration for the winter months, and are greatly relished by the hares. The hares should be watered every day. A large lump of rock-salt should be placed in each hutch. Each hare has an individual disposition, and the breeder should study their habits and likes and dislikes, and try to give them what they desire. Some eat more hay than others, while some want more grain. For breeding does and their young, nothing is so good as bread and milk. The bread should not be musty, and the milk should be sweet. This makes the youngsters grow fast and the doe gives more milk.

Housing the hares.—No special building is required. A barn, stable, or shed, reasonably warm in winter and permitting thorough ventilation, but free from draughts, is all the shelter that is necessary. Almost any building can be fitted very quickly by one who is handy with tools. The writer has erected a special building for housing his hares, after the following general plan: The building is 40 feet long and 8 feet wide. It is 9 feet high in front and 8 feet high on the back. This building is placed on sewer tile, 10 inches in diameter, which is filled with portland cement and placed in the ground about 12 inches, on a cement foundation below the freezing-point. There are eight of the tile, filled with the cement, placed at proper distances for the building proper to rest on. The purpose of having the building about eighteen inches from the ground is to make it rat-proof. Old rats are very destructive to young Belgian hares when they have access to them. The writer has known rats to destroy a whole litter in one night.

This building is divided into twenty separate rooms or hutches by a "double-deck" arrangement, each hutch being eight feet long by four feet wide. The lower tier of hutches is three feet in height from the ground floor to the floor of the upper tier. In the lower tier all the partitions are made of lumber. The writer has found oak lumber to be the most satisfactory for the entire construction. This does not make so attractive a house as would pine, but it will be remembered that Belgian hares seldom, if ever, gnaw oak lumber, which is not the case with pine or softer woods. The partitions in the upper hutches are made with lumber for about three feet from the floor; then the upper part is made with poultry netting, which is cheaper than lumber, and gives the top hutches better ventilation.

The roofing of this building is of galvanized iron, which seems to be better and more economical than shingles. The doors in the hutches are three feet long (the long way of the building) and two feet high. The frame is made of oak, and the remainder of one-inch poultry netting. The doors are hung with six-inch hinges, and hasps are used to fasten them. The building faces the south. Several trees are so planted as to give it shade in the hot days of summer. The building is enclosed in a yard as described below.

Yards and parks.—A suitable site for a yard or park for Belgian hares should be slightly sloping, so as to secure good drainage when heavy rains come. There should be a tree of some kind for each separate enclosure, to give the necessary shade in the hot summer days. The writer does not recommend fruit trees for this purpose, as when the fruit falls the hares may eat too much and get sick or die. Apples and pears are not harmful to them if fed in small quantities. The writer has what he considers an ideal park for the raising of Belgian hares, made, in general, as follows: The park is laid off fifteen rods long by five rods wide. The outside is made of six-foot Page poultry-fence, so as to keep out all dogs and other animals that would be likely to harm the hares. The inside partitions may be poultry-netting, four feet high. The park is divided into fifteen different yards, making each yard nearly five rods long by one rod wide.

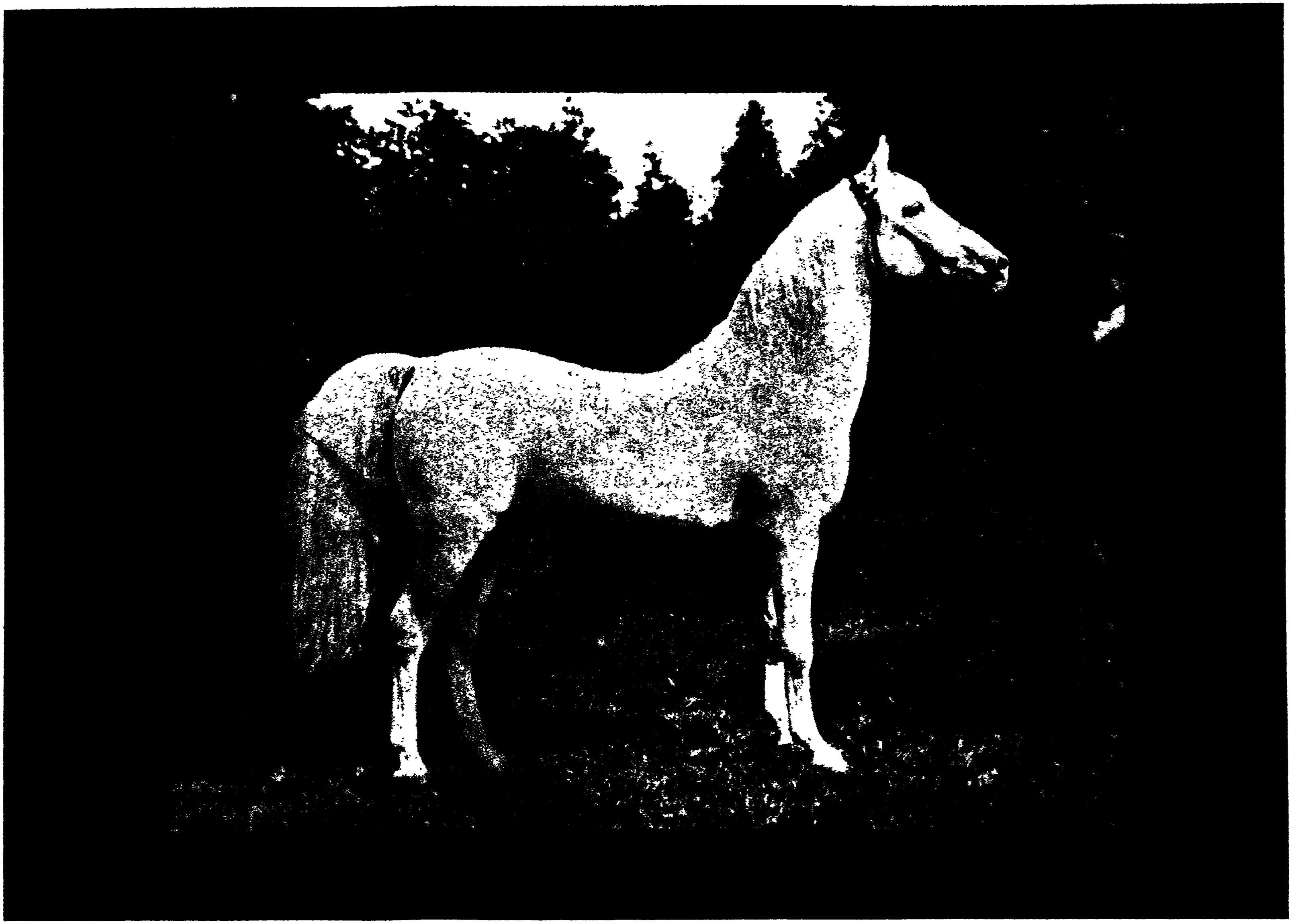

Plate XIII. Arabian horse, Shahwan (deceased). Bred in Egypt and owned in England and then in America

There is an eight-foot aisle running the long way of the park, so as to make feeding easy for all the yards. Before erecting the fence and netting, a furrow should be plowed in each place the netting is to be stretched and also for the outside fence. After the fence and netting have been properly stretched, the dirt should be filled in again around the netting and fence. The burying of the fence and netting is to keep the hares from digging out, and anything else from digging into the park.

Uses.

For meat.—The principal value of the Belgian hare is for its meat. The little care required in its raising makes it a source of profit even to the person who raises only enough for his own use. The meat is white like the breast of chicken. The Belgian hare will dress a pound for every month of its age up to six months, and it will furnish food for the table any time after two months old. The most profitable age to kill for market is about the fifth month. All the flesh is edible, so there is practically no waste if the animal has been properly dressed. It has been estimated that one breeding doe will produce over 300 pounds of meat in one year.

For fur.—Mention should be made of the fact that Belgian hares are valued to some extent for their fur. This comprises much of their interest to fanciers.

Diseases.

When proper attention is given to feeding and housing, and cleanliness of the hutches made a matter of first importance, and a good disinfectant intelligently used, no trouble will be experienced in keeping Belgian hares in good health and condition. Cold and catarrh are troublesome, and should be treated with human remedies in proportion to weight. Indigestion is best cured by proper feeding—by the addition of pepsin or other remedy to food that is easily digested.

The most common disease, and perhaps the worst to which the Belgian hare is subject, is snuffles. The treatment of this disease is to build up the system. Food that is extra nourishing, and a little tincture of iron in the drinking water, may be all that the animal will need to be able to throw off the disease. If a mash is fed, about a spoonful of flaxseed may be put in it, and if it is simply a case of sneezing and discharge from the nose resulting from a slight cold, nothing more in the way of treatment will be required. It will be well to spray the nose with lukewarm water, to which a little salt has been added; after spraying, wipe dry.

Organizations and records.

At present, the American Fur Fanciers' Association, with headquarters at Great Neck, New York, is the only organization devoted to the Belgian hare industry in America. A few years ago, when the raising of Belgian hares was a fad, there existed the National Belgian Hare Club of America, with headquarters in Denver, Colo., and the American Belgian Hare Association. Both of these have discontinued.

Literature.

Books treating on the Belgian hare: Eph. Ruth, American Belgian Hare Culture; Eph. Ruth, Belgian Hare Breeding and Management; P. E. Crabtree, Belgian Hare Course of Instruction; Jacob Biggle, Biggle Pet Book, illustrated; U. G. Conover, The Belgian Hare for Pleasure and Profit; The Belgian Hare Guide, illustrated; Cuniculus, The Practical Rabbit Keeper; W. N. Richardson, The Rabbit: How to Select, Breed and Manage, sixth edition.

HORSE. *Equus caballus*, Linn. *Equidæ.* Figs. 421–495.

As a domestic animal, the horse has had an aristocratic history. In the earliest historic times he was used chiefly for purposes of war, and literature abounds in allusions to this fact. He was the animal of emperors and of persons of noble birth, associated with chariots and with great occasions. With certain nomadic peoples, he early became the agent of speed. Gradually, he was pressed into the common work of the world and became one of the beasts of burden, gradually supplanting the ox. Today, with the cow, the horse is one of the indispensable agents of the agriculture of the western nations.

The horse is now bred chiefly for five types of uses: (1) For speed, as in the trotters, pacers and runners; (2) for sport, fancy and fashion; (3) for family driving; (4) for draft purposes, largely in cities and towns; (5) for general farm uses.

It is in the last of these uses that the horse is of greatest real value to man, and yet it in this very respect that he has received the least definite intelligent breeding. There is no real farm horse in this country, except as animals of mixed and miscellaneous breeding, or of no breeding, are used for general farm purposes. Of course, the farm purposes are not single or uniform, for in some farm business heavy draft animals may be needed and in other business light roadsters may be needed; but it is nevertheless a fact that when the farmer breeds definitely to race-type or breed-type, he is thinking of horses to sell to men in other business rather than to sell to farmers or to produce the best type for his own farm uses. Practically all the farm-work horses are mongrels, with no such care having been devoted to their parentage and pedigree as is devoted to dairy cows, beef cattle, bacon hogs or egg-laying fowls. The books usually consider the horse least of all from the farm-utility point of view. The sportsman, fancier and city trucker have thus far had the greatest influence in the breeding of types of horses. All this must change if agriculture is to reach its highest efficiency; for the horse is to remain an indispensable factor in country life, despite all that is said and done about automobiles and mechanical power. Heavier horses are needed for the better and deeper fitting of the land; much of our agriculture has

been weak because there has been insufficient horse power properly to fit the land. But the general farm horse, particularly on hilly farms, must be not merely a heavy draft animal: he must have ease and alacrity of motion and not such size and weight as will make him clumsy. It is not likely that a distinct registered breed of special farm horses will arise; but it is eminently desirable that ideals be formed and that they be related to farm necessities and the animals bred definitely for such uses.

Aside from the dog and cat, the horse is more closely associated with man on the personal side than any other domestic animal of temperate countries. He becomes an object of personal regard on the part of members of the household; and he has been provided with better quarters and given greater care than any other animal. He is the only farm animal of this country with whom human beings share living quarters under the same roof; it is common for care-takers to live over stables, and some of the most artistic of suburban and farm buildings are devoted to such dual purpose. (Fig. 421.) The attention given to horse-stable construction and to harness and other equipage, as well as to breeding for personal purposes, has resulted in a large special literature on the horse.

The number of horses in the United States and Canada is practically equivalent to the number of dairy cows. According to the Yearbook for 1906, United States Department of Agriculture, the number of horses in America was as follows:

	Year	Total
United States:		
Contiguous—		
On farms	1907	19,747,000
Not on farms	1900	2,936,881
Non-contiguous		
Alaska (on farms)	1900	5
Hawaii (on farms)	1900	12,982
Porto Rico	1899	58,664
Total United States (except Philippines Is.)		22,755,532
Canada:		
New Brunswick	1905	62,000
Ontario	1906	688,147
Manitoba	1906	215,819
Saskatchewan	1906	240,566
Alberta	1906	226,534
Other	1901	531,249
Total Canada		1,964,315

The same Yearbook gives the number and farm value of horses in the United States:

		Price per head	Farm value
January 1, 1867	5,401,263	$59 05	$318,924,085
January 1, 1907	19,746,583	93 51	1,846,578,412

The Canada Yearbook for 1905, gives the value of horses in Canada in 1901, as $118,279,419. The number of horses over three years of age in Canada in 1871, is given as 643,171, and in 1901, as 1,304,910; the number of horses under three years of age in 1871, is given as 193,572, and in 1901, as 272,583.

Literature.

The literature relating to horses is more abundant, perhaps, than is the case with the other classes of farm live-stock. Yet there are few monographs; some of those that have appeared are mentioned in connection with the discussions of the breed or type to which they refer. Plumb, Types and Breeds of Farm Animals, Ginn & Co. (1906); Roberts, The Horse, Macmillan Company (1906); Wallace, Farm Live-Stock of Great Britain, Orange Judd Company (1908); Craig, Judging Live-Stock, The Author (1902); Youatt, The Horse, Philadelphia (1848); Walsh, The Horse in the Stable and in the Field, London (1871): Speed, The Horse in America, New

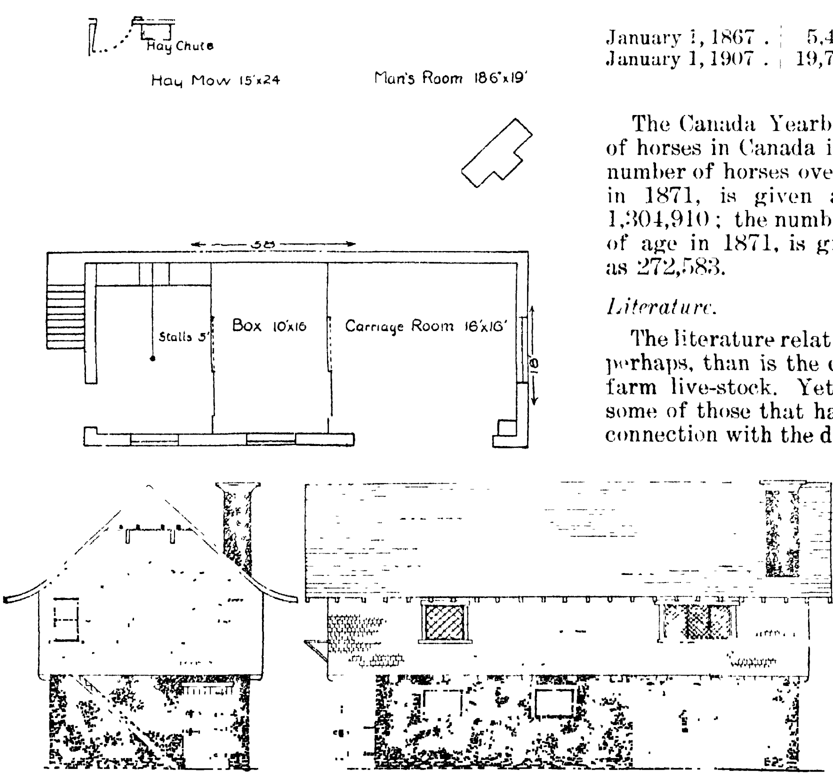

Fig. 421. Plan and elevation of horse barn, with hostler's quarters.

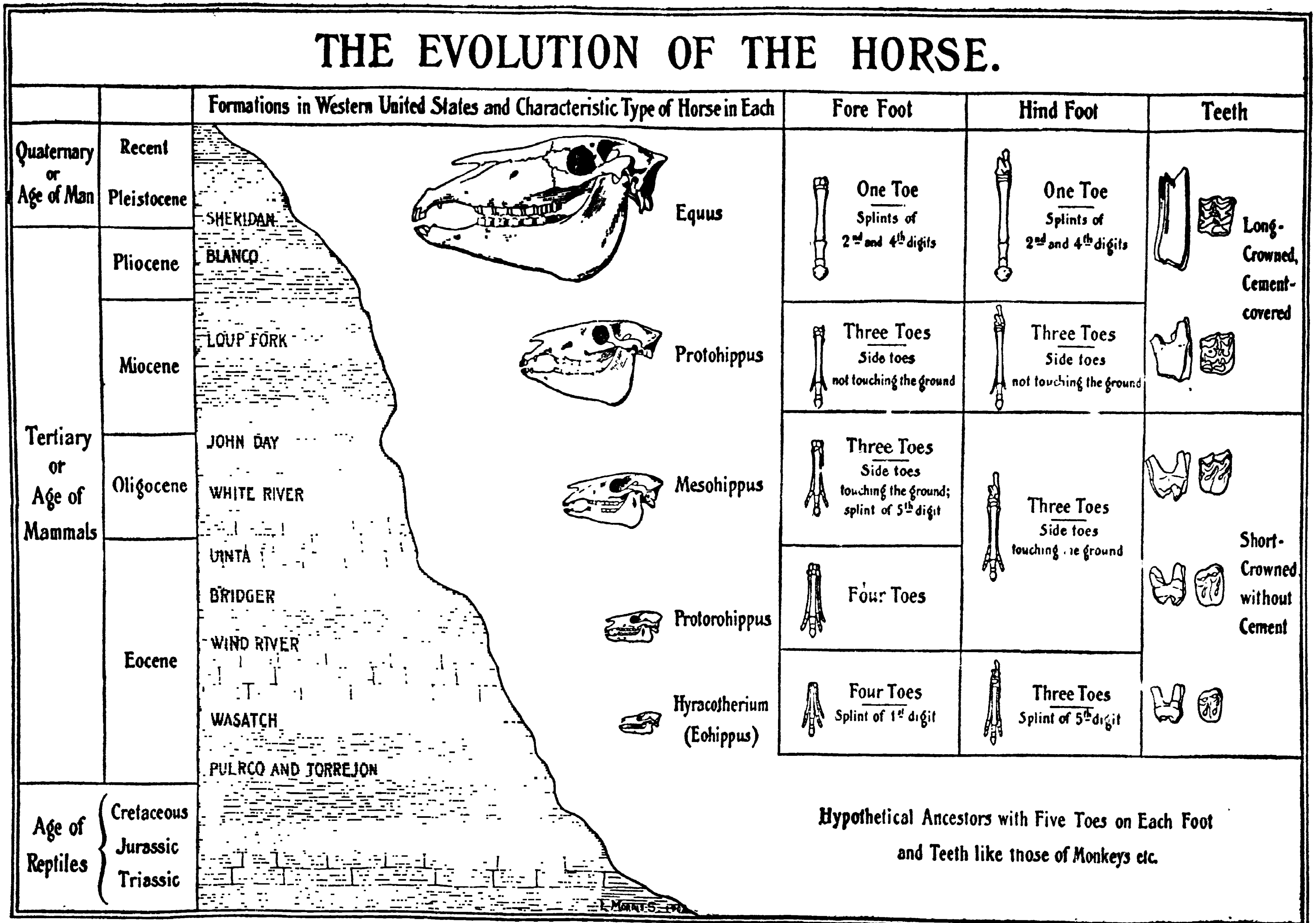

Fig. 422. **Epitome of the history of the horse.** As shown in the collections of the American Museum of Natural History, from a diagram prepared by Dr. W. D. Matthew. This figure shows the geological section in which the horses occur, increase in size of the skull, and the development of the fore-feet, hind-feet and teeth. (After Osborn.)

York (1905); Sidney, The Book of the Horse, New York; Sanders, Horse Breeding, Chicago (1893); Anderson and Collier, Riding and Driving, New York (1905); Blew, Light Horses: Breeds and Management, London (1894); Busby, The Trotting and Pacing Horse in America, New York (1904); Day, The Horse, London (1890), and The Race Horse in Training, London (1892); Gilbey, Riding and Driving Horses, London (1901); Fowler, The Horse, London (1891); Hayes, Points of the Horse, London (1897); Helm, American Roadsters and Trotting Horses, Chicago (1878); Dimon, American Horses and Horse Breeding, Hartford (1895); Herbert, Frank Forester's Horse and Horsemanship of the United States, 2 volumes, New York (1871); Heavy Horses: Breeds and Management, London (1895).

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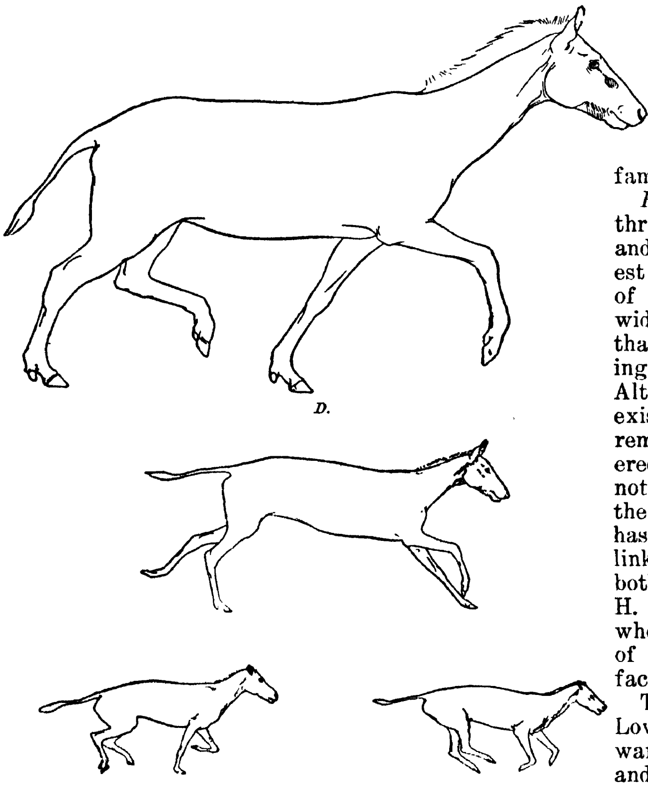


Fig. 423. Illustrating the increase in size of the horse. *A*, The ***Eohippus***, the smallest Lower Eocene horse known; *B*, the ***Orohippus***, the Middle Eocene horse; *C*, the ***Mesohippus***, the Lower Oligocene horse, four and one-half hands high; *D*, the ***Hypohippus*** or "forest horse." (After Osborn.)

Origin of the Domestic Horse. Figs. 422-428.

By *Frederick B. Mumford.*

In a zoölogical sense, the horse is a vertebrate animal belonging to the class Mammalia, the family Equidæ and the genus Equus. In a broad sense, the word horse applies to all members of the family Equidæ, and all the existing members of this family are included by Linnæus in the genus Equus. The representatives of this class are distinguished by a single hoof, a simple stomach, long, muscular legs and a very high order of intelligence. They all have hair on the neck, forming a mane, and the tail terminates with or is covered with long coarse hair. The voice is loud and often harsh, the ears are movable and the hearing very acute. Most members of the horse family are gregarious.

Prehistoric horse.—The evolution of the horse through various lower forms to the present useful and universally admired form is one of great interest to all students of the progressive development of animals. From fossil remains scattered over widely separated regions of the earth, we know that the extinct horse became world-wide (excepting Australia) in its geographical distribution. Although the modern form of the horse did not exist on the American continent, many fossil remains of the prehistoric horse have been discovered in New Jersey, Nebraska, South Dakota and, notably, Wyoming. The gradual modification from the various prehistoric forms to the modern horse has occupied millions of years. The more important links in the chain of descent have been described both as to period of existence and general form by H. F. Osborn (Century Magazine, November, 1904), whose researches, partly following the early studies of Leidy and Marsh, have been drawn on for the facts given below.

The earliest prehistoric horse existed in the Lower Eocene period, ranging from Mexico northward, and inhabiting parts of continental Europe and Great Britain. (Figs. 422, 423.) This early horse was no larger than a small dog, which it resembled. The color was probably dun, with inconspicuous spots or stripes. The Eohippus (Marsh) or "dawn horse," as this form was called, possessed four toes on the front-, and three on the hind-foot.

In the next higher form, the Orohippus (Marsh), of the Middle Eocene period, the splints have disappeared, leaving four toes. The animal is still small, being about fourteen inches high. This form was discovered in the Big Horn mountains of Wyoming in 1880. There appeared later in point of development the Mesohippus, from the Oligocene period, which exhibited unmistakable evidences of rapid progression toward the modern horse. This form was eighteen inches in height, and had virtually lost all but three toes. The middle toe is

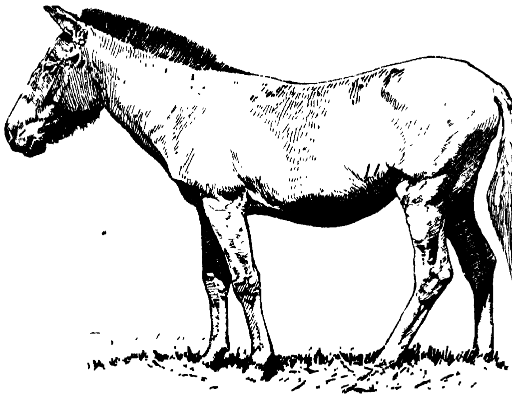


Fig. 424. Prejvalsky horse (*Equus Prejvalskii*) After Osborn.

enlarged, and bears more of the weight of the animal, although the two remaining toes still touch the ground.

An important side line was discovered in the Hypohippus (Leidy) or "forest horse," in eastern Colorado, in 1901. This form was forty inches high, provided with large lateral toes which supported the animal on the soft marshes of that period. During the same year, the explorers, working with the aid of the Whitney fund, discovered the remains of several three-toed horses, some of which were widely different from the "forest horses." This form, called the Hipparion (Neohipparion), was distinguished by a remarkable deer-like conformation which indicated the development of great speed. Osborn says, "Neohipparion was proportioned like the Virginia deer, delicate and extremely fleet-footed, surpassing the most highly bred modern race horse in its speed, and with a frame fashioned to outstrip any type of modern hunting horse, if not of the Thoroughbred." These somewhat extreme developments of structure soon became extinct, while the Protohippus of intermediate form became the direct progenitor of the modern horse.

In this type we find but one toe touching the ground, with two lateral and rudimentary toes corresponding to the splints in the modern horse.

The last stage in the development is represented by Equus, the modern horse, which is characterized by graceful limbs, terminating in a dense hoof covering the single middle toe. The remaining toes have disappeared, but vestiges of two toes are to be found in the splints on both fore- and hind-legs.

The present horse is much larger than any of the prehistoric forms. The gradual development of the giant draft horse of today, from the early Eohippus, a small dog-like animal no larger than the fox terrier, is a most interesting phenomenon.

Connecting and side branches of the modern horse and the prehistoric forms described above are probably to be found in the zebra, the wild ass, and an interesting form of the wild horse called Prejvalsky horse. (Fig. 424.) The latter was discovered on the Dzungaria desert in western Mongolia, in 1881, by Poliakoff. This horse very much resembles the drawings found in the French caves, along with other relics of the stone age.

Modern Equidæ. - The present living forms of the Equidæ include three types: *Equus caballus*, the horse proper; *E. asinus*, or the wild ass, and the *E. zebra*, related to the various striped forms of zebras and quaggas.

The *E. caballus* is distinguished by long hair growing thickly on all parts of the tail, a callosity on the inside and below the hock and knee, mane long and flowing, ears short, limbs long, feet broad and head small. The wild horse is dun colored and sometimes faintly striped. Wild horses are at present found in but a very few remote localities. Feral horses, called Tarpans (Fig. 425), are found on the steppes north of the sea of Azoff, between the Dneiper river and Caspian sea.

The *E. asinus*, or wild ass (Fig. 306), is characterized by long ears, narrow hoofs, rather sharp back, an absence of callosities on the inside of legs, and a tail "tuft." In a wild state, the ass is very alert, vigilant and fleet. There exists no authentic record of the time when this animal was first used by man as a beast of burden, but the

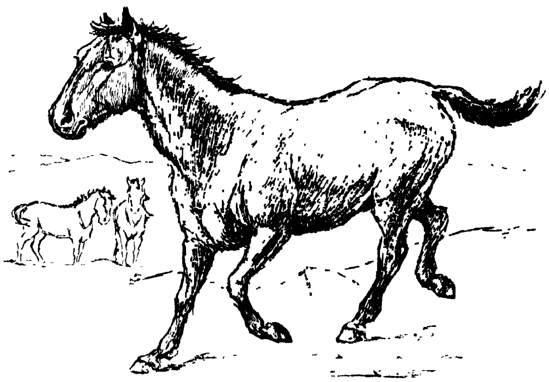


Fig. 425. Tarpan (*Equus tarpan*).

domestication of the ass antedated that of the horse.

The zebra (Fig. 426) and quagga (Fig. 427) are much like the ass but are beautifully striped with black on a dun- or drab-colored foundation. They breed successfully with the horse, and the progeny, called a zebroid (Fig. 428), resembles the mule and is sterile. The zebra, which was long considered untameable, has been successfully broken to harness. The zebroid, zebrule, or zebra mule, has recently claimed much attention because of the

success attained in breeding it by Professor Ewart, of Pencuik, Midlothian, Scotland. The zebroid is strong and can be broken to harness and to saddle.

The domesticated horse.—The value of the horse as a powerful aid to man in his conquest of the

Fig. 426. Zebra (*Equus zebra*).

earth did not at first appeal to primitive man. It appears that the horse was first used for food. He was later driven, then ridden, and lastly employed as a beast of burden.

The first authentic evidence of the use of the horse by man was discovered in the cave of La Mouthe in France. In this cave, among the interesting relics of the stone age are drawings which represent the horse as varying somewhat in size and character but resembling closely the present wild forms. From other sources it seems certain that there existed a larger type in the south of Europe and a much smaller form in the north.

The progenitors of our present horse can not always be clearly traced. According to Ewart, Ridgeway, Osborn and others there may have been several distinct wild forms directly preceding the modern horse. Ewart has described the Celtic pony, a small dun-colored horse found in the

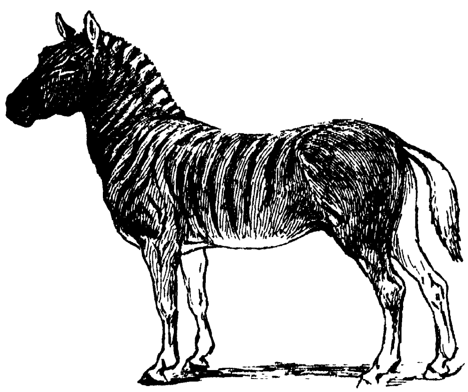


Fig. 427. Quagga (*Equus quagga*).

islands of the Hebrides and in Connemara, Ireland. This hardy animal resembles closely some of the illustrations found in the cave of LaMouthe and may have been the progenitor of the numerous pony breeds. A second form is much larger, over fourteen hands high, also of a dun color, with large coarse head and thick limbs. This form is widely distributed over Europe and Asia. The most ancient horses of the Assyrians, Persians, Greeks and ancient Britons were of this type. It is also probable that the horses of the ancient Chinese resembled very closely this unimproved horse.

Still another distinct type seems to have existed in the south and later became the foundation stock of the beautiful horses of Persia, Arabia and the Barbary states in northern Africa. It now seems probable that it is principally to this form that we must look for the original stock of the modern Thoroughbred trotting horse, saddle horse and other races of speed horses.

This ancient stock, so fruitful in ultimate results as exhibited by these highly improved blood horses, probably had its origin in the dry desert regions of northern Africa. The more modern representative of this race is called the "Barb," and it is the horse that was principally employed in the improvement of the English Thoroughbred,—a breed of such remarkable endurance, great speed and beautiful symmetry that it has been imported into

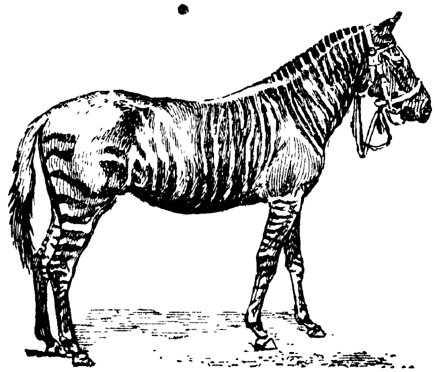


Fig. 428. Zebrul or zebroid. Cross of a Burchell zebra on Irish mare. (After Wallace.)

every civilized country in the world, and has contributed to the founding of every important breed of light or speed horses in existence.

A great variety of domesticated races, called breeds, have been developed from the wild forms described above. These various types may be classified as draft, coach, roadster, speed and saddle horses and ponies. The principal draft breeds in America are the Percheron, Clydesdale, Shire, Belgian and Suffolk. The coach-horse type is represented by the Hackney, French coach, German coach, Cleveland bay and some strains of the American trotter. The roadster is a light driving horse, developed from the American trotter. The speed horses are the American trotter or pacer, the Orloff trotter, and the Thoroughbred or English running horse. The saddle horses are the American or Kentucky saddle horse, the hunter and the cavalry horse. The pony breeds are the Shetland, Welch, Exmoor, Mustang, Indian pony, and others. More recently the effort has been made to develop a particular carriage type of the American trotter, and

it is suggested that this new type of sub-breed be called the American carriage horse. In addition to the breeds named above, of special interest to American readers will be the mention of the old Conestoga draft horse, which originated on the banks of the Conestoga river in southeastern Pennsylvania. This horse was of medium size, of rugged constitution, pleasing conformation and of great endurance.

The word "type" used above is a generic term, employed to designate a group composed of breeds or races of similar size, conformation and utility. The word "breed" is a specific term and applies to smaller groups of animals more closely resembling one another, and usually taking their name from the locality in which they originated. "Grade" is a term widely used to apply to animals having a preponderance of the blood of a well-recognized improved breed. A "cross-bred" is an animal resulting from the mating of animals of distinct breeds.

The Education, Harnessing and Gaits of the Horse. Figs. 429–435.

By *Thomas F. Hunt.*

The education, harnessing and gaits of the horse, in their practical aspects, involve many problems and much detail that cannot be given here. A few of these practical problems are indicated in the succeeding article by M. W. Harper. The references to literature at the end of this article will aid the reader in finding some of the most valuable published information on horse-training. In the great mass of literature relating to this subject, one needs to choose carefully between what is really worth while and what is largely sentiment.

Education.

It is not the purpose to discuss the education of the horse in detail nor to give methods by which it may be accomplished, but rather to state briefly some general principles that must underlie any successful training. For methods of training horses, as well as for the proper manner of riding, see Anderson's "Modern Horsemanship" and Hayes "Illustrated Horse Breaking."

It is necessary to understand the mental processes of the horse in order to train him rationally. His mental processes can be determined only by inference; and it may seem unjust, but if the matter is considered candidly and without sentiment, it must be concluded that the horse is a rather stupid animal. He appears, also, to have little affection for other species of animals, man included, and, so far as man is concerned, has little love of admiration. The dog, for example, will do many things to please because he loves to be admired. It is doubtful, therefore, whether any system of petting or cajoling as a method of horse-training is of much avail.

Apparently, the horse has but limited reason (using the word for whatever mental processes are present with the horse), much more limited than that of the elephant or the dog. On the other hand, the horse seems to have an excellent, perhaps rather extraordinary, memory. If a horse is conquered by means of properly arranged straps and ropes, he does not seem to be able to reason that when the straps and ropes are taken off he could run away if he chose. While he seems always to remember that the pulling on the bit, which was done at the same time his front feet were pulled up, was intended to make him stop, he does not seem to be able to reason that it was the pulling his feet off the ground and not the pulling on the bit that stopped him during his first lesson.

Both because of his most excellent memory and poor reasoning power, it is very important that every stage in the process of training should be successful. The spirit of bravado should not permit the undertaking of a step which cannot be accomplished with certainty. If a horse throws one off he is not likely to forget it, and is just as likely to do it again as to do any other thing that he has been trained to do. If he learns that certain things will not hurt him he will generally remain gentle to their influences.

As in the child, the vividness with which impressions are made on the horse's mind determines, to some extent, the accuracy and certainty with which they are remembered. Herein often lies the value of those horse-breaking methods that induce the horse to resist, and that at the same time contrive effectually to overcome this resistance. The impression made during the fight is so indelibly impressed on the horse's mind that he rarely forgets it. Habit is also an important factor, and hence the repetition of lessons is essential to the thorough education of the horse.

During lessons, the trainer should receive the undivided attention of the horse. It is desirable, therefore, to train him in a comparatively small enclosure, say seventy-five to one hundred feet in diameter, and containing no other person or objects which may attract the horse's attention, except the trainer, and an assistant, if needed. For the same reason, a single lesson should not be too long, since when the horse becomes tired his attention can not be secured.

The ultimate purpose of training is to make the horse understand and obey signals. Signals may be made with the voice, the whip or the lines. In any case, they should be made clearly, and a given signal should be made for a single purpose. Perhaps the greatest fault with persons in handling horses is that they do not use their signals consistently, and do not insist on the horse obeying them. If "whoa" is used as a signal for a horse to stop, it should not be used when it is desired merely that the horse should go slower, but some other signal should be used, as for example, "steady." The reason more confusion is not experienced in the use of the signal "whoa" is from the fact that the user consciously or unconsciously modifies the volume of the voice, and the horse depends on this emphasis for his signal. Obviously, a change both in the word used and the volume of the voice would be more desirable.

Manifestly, the command to stop should precede and not succeed a pull on the bit. One would hardly think of whipping a child before telling him

to shut the door in order to make sure of his command being obeyed. One should not pull on the bit both to make a horse stop and to make him go faster. The horses that ran away when pressure was put on the bit and ran faster the more the pressure was exerted, but stopped immediately when the driver slackened the lines, were not vicious horses. They were simply obeying the signals their former driver had unwittingly taught them.

Punishment, whether by pressure on the bit or otherwise, should cease the moment the horse does what is desired of him. Punishment may be inflicted to induce a horse to perform an act or to refrain from the performance of an act, but must never be inflicted after the act is performed, no matter how undesirable the act may be. One may properly punish horses to cause them to pass an automobile, but to inflict pain after they have passed it will only give them just cause for fear the next time they meet one.

A bit or the arrangement of the bit that constantly hurts the horse gives him no idea of what is wanted of him. Almost any horse will do as directed to avoid pain, provided he understands his directions and provided doing it actually relieves him from the pain. The horse or the child that is punished whether he does right or wrong, is just as likely to do the wrong thing as the right thing.

The use of the martingale is a good example of the proper and improper application of punishment. The standing martingale is attached directly to the snaffle-bit, while the rings of the ordinary kind slide on the rein. The martingale is used with the saddle horse to prevent him carrying his head too high or too nearly horizontal, or to prevent him hitting the rider with his head. With the standing martingale, every time the horse throws his head too high the punishment is inflicted, and the moment he holds his head properly he gets immediate relief. With the ordinary martingale, a rider is about as likely to pull on the bits whether the head is high or low.

This principle of punishment only for the purpose of securing obedience to properly conveyed and properly understood signals, and the immediate cessation when a signal is obeyed, is the keynote of successful horse-training.

Harness.

When the harness with which a horse is dressed comes to be examined critically, certain parts will be found to serve essential purposes, while other parts may be found to be like the buttons on the back of a gentleman's coat, remnants of former customs or conditions. Obviously, harness may serve three main purposes; viz., to enable the horse to move the vehicle, to enable the driver to guide the animal or regulate his speed, and to improve the appearance of the animal or add to the impressiveness of the equipage as a whole.

The collar, hames, tugs, breeching and neck-yoke strap are concerned chiefly in the movement of the vehicle. The back-band may serve a variety of purposes. In some instances it supports the shafts, while in others, it, in connection with the belly-band, gives anchorage for the neck-yoke strap. In connection with the coupler it also serves as an attachment for the check-rein. When breeching is used, the back-band is sometimes omitted, the check-rein, if present, being supported by the hames.

Since practically all the force of propulsion is conveyed through the collar, this becomes the most important single item of harness in the draft horse. It is essential that the collar should be the proper size and shape and the hames properly adjusted. Obviously, the aim should be to distribute the pressure of the collar as widely and evenly on the shoulders as possible. If the tugs are adjusted too low, there is danger of too much pressure on the point of the shoulder, causing collar boils; if too high, there may be too much pressure on the neck, causing soreness there. The point of attachment may need to be modified for the same horse, depending on the direction of the tug. Wheeled vehicles permit of a more nearly horizontal line of draft than do plows, harrows and similar tools.

The bridle and lines form a means by which signals are conveyed by the driver to the horse. While there are a multiplicity of bits intended to convey varying degrees of pressure or pain, in general the simpler the form and the less the pain inflicted the easier the horse is controlled. In fast driving or riding, more pressure on the bit is desirable than at the slower gaits, because of the more constant and delicate guidance required. With regard to the use of bits, it is necessary to remember that the horse is a sentient being having individuality which may amount to idiosyncrasy, and that, therefore, the bit which gives the best result with one horse may not be best for another.

In order to understand fully the uses of bits, it is necessary to distinguish between the different purposes for which horses are employed. For work horses, both the lines and the check-rein are attached to an ordinary snaffle-bit. The side check-rein is used, the chief purpose of which is to prevent the horse getting his head to the ground and thus getting into mischief when left standing. Since a horse can pull most advantageously when his head is low and well forward, the check-rein should permit a reasonable movement of the head. In the case of driving horses or coach horses, draft is less essential, while speed or action becomes the important consideration. Speed is increased by raising the center of gravity and thrusting it forward. Action is increased at the expense of speed by raising the center of gravity and thrusting it backward. Since, in the horse, the center of gravity is modified by the movement of the head, it is possible to modify speed or action by changing the position of the head. In driving horses, therefore, a snaffle-bit is used for the lines, while a straight bit attached to an overdraw check is used to raise the head and cause it to assume a somewhat horizontal position, thus throwing the center of gravity of the horse forward and upward.

In coach horses, action is demanded, but great speed is not required. In other words, the coach horse is expected to raise his feet as high as may be with relatively small forward movement. This is facilitated by bringing the horse's head into a comparatively vertical position at the same time that it is raised. To bring this about, a curb-bit is used, the lines being attached to the longer arms of the lever, and the curb forming the resistance to the shorter arm. Side-reins are used to keep the head up. These are sometimes attached to the center rings of the curb-bit, but, to secure the best results, the check-rein should be attached to a separate snaffle-bit, for reasons given in explaining the use of the martingale.

The horse may be ridden with either the snaffle- or the curb-bit, but for high-class work, both should be employed. The curb-bit is used at the gallop and the single-foot, while the snaffle-bit is used at the walk and trot. The two bits add to the safety of the rider and increase the distinctness with which signals can be conveyed.

Many trotting horses are transformed into coach horses by substituting curb-bits and side-reins for snaffle-bit and overdraw check, replacing the breast-collar with the ordinary collar, and by docking the tail. Sometimes heavier shoes are also put on, to make the horse lift his feet higher, and not reach so far forward. Driving-horses with breast-collars should have bridles, rings, and other metal parts as inconspicuous as possible. Coach horses may have hames, buckles, rings and other metal trimmings made prominent by the use of nickel, brass, silver or gold, according to the taste and means of the owner.

Gaits.

There are four distinct gaits or types of locomotion, viz., the amble or pace, the trot, the walk and the gallop. There are also several intermediate gaits. Thus, the so-called gaited saddle horse may go the last three of these distinct gaits and two intermediate gaits, the rack and the running-walk. In place of the running-walk, other intermediate gaits are permitted, but the true amble or pace is not allowed as a saddle gait. There is great difficulty in distinguishing and classifying the intermediate gaits because there may be all sorts of gradations between the distinct types. This will be clear if these gaits are represented diagrammatically. Let the shaded areas represent the right feet and the solid black areas the left feet. In the diagrams (Figs. 429–435) let the upper line represent the front feet and the lower line the hind-feet. The three gaits may then be represented as shown in Figs. 429–431. It will be readily seen

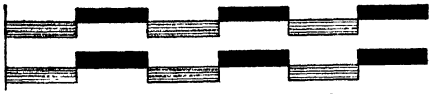


Fig. 429. The pace or amble.

that in the pace or amble (Fig. 429) the lateral bipeds strike the ground simultaneously and make two beats for one step; that in the trot (Fig. 430)

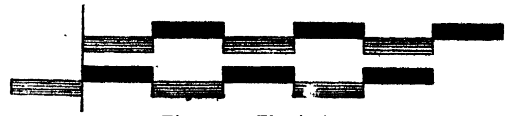


Fig. 430. The trot.

the diagonal bipeds strike the ground together and thus again make two beats for one whole step; while in the walk (Fig. 431) there is a condition

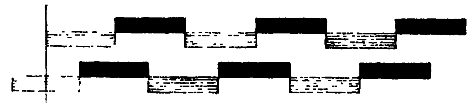


Fig. 431. The walk.

just half-way between the pace and the trot, consequently each foot strikes the ground separately, making four equally spaced beats. It is perfectly evident that there may be all sorts of gradations between the pace and the walk or between the walk and the trot. If a horse went a gait that was just half-way between a pace and a walk, it would be represented as in Fig. 432. It will be seen that

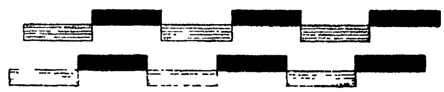


Fig. 432. The rack.

in this case each foot strikes the ground separately; but instead of being equally spaced there are four unequally spaced beats, giving the familiar sound of the single-footer: *peck-a-peck, half-a-peck.* It is probable that the single-foot is not just half-way between the walk and the pace, but that it is nearer the pace than the walk.

A gait half-way between the walk and the trot would be represented as in Fig. 433. In this case

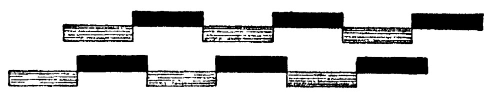


Fig. 433. The running-walk.

each foot strikes the ground separately and in unequally spaced beats, but instead of the lateral bipeds being closely associated it is the diagonal bipeds that are associated.

In the gaits that have just been described there are either two or four beats to a complete step. In the gallop, however, there may be but three beats. In this gait, assuming the horse to be off the ground, he strikes the ground first with one hind-foot, say the right, then simultaneously with the left hind-foot and right fore-foot and then with the left fore-foot. Sometimes, although less frequently, the horse strikes the ground with, say, the right hind-foot, then with both left feet and then with the right fore-foot. This is known as the lateral or disunited gallop (Fig. 434), while the former and more usual gallop is known as the diagonal or united gallop (Fig. 435).

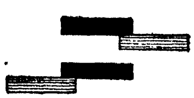


Fig. 434. Lateral or disunited gallop.

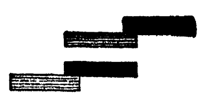


Fig. 435. Diagonal or united gallop.

The horse in the gallop is said to lead with the foot that strikes the ground last. Inasmuch as the horse strikes the ground first with one hind-foot and leaves it from the diagonal fore-foot, while the other diagonal biped receives the concussion at the intermediate beat, it is evident that it is desirable for saddle horses to be able to change the lead in order to rest themselves and in order that the diagonal biped shall not be prematurely worn out. When a horse gallops in a circle, the center of gravity is thrown in to overcome centrifugal force. As the horse is in danger of falling inward under these circumstances he should and generally will lead with his inner fore-foot. Advantage can be taken of this fact to teach a horse to change his lead from one to the other fore-foot. If a horse is ridden in a small circle to the right, the rider throwing his own weight inward and turning the horse's head slightly outward at the start, it will tend to make the horse lead with the inner fore-foot. The lead may be reversed by riding to the left. After the horse will take the lead readily by riding either to the right or to the left, he may be ridden in the figure eight, in which case he should change the lead as he changes from one circle to the other. When a horse is thus trained he may be induced to lead with the right foot when moving in a straight line by turning the head slightly to the left while the rider throws his own weight to the right. To lead on the left foot, reverse the operation.

For the purpose of simplicity, only the order and association of beats have been represented in the diagrams. As a matter of fact, at the walk a horse has at certain times three feet on the ground, while in the fast trot there are times when all the feet are off the ground. In the running-walk and in the broken amble or rack, at times the horse has three feet on the ground, but not for so large a proportion of the time as in the walk.

Literature.

Goubaux and Barrier, The Exterior of the Horse, translated by Simon J. J. Harger, J. B. Lippincott Company (1892); Anderson and Collier, Riding and Driving, New York (1905); Herbert, Frank Forester's Horse and Horsemanship of the United States, 2 Vols., New York (1871); Marvin, Training the Trotting Horse, New York (1892); Anderson, Modern Horsemanship; Hayes, Illustrated Horse Breaking; Roberts, The Horse, the Macmillan Company (1905). [For further references, see page 416.]

Practical Horse-training and Handling. Figs. 436, 437.

By *Merritt W. Harper.*

Not every person is fitted by nature for the training and care of horses, as the large number of vicious and spoiled horses indicates. Many of the ailments of horses are due, not so much to bad breeding, as to faulty training and ignorant, brutal driving. When the horse has been well trained, he may be depended on, especially if this training is given in his early years. He will never forget these early lessons. In the training of the horse, it is of very little use to try to lay down set rules. The man who trains colts finds new situations to deal with in every individual he undertakes to educate.

In training the horse, there are a few things that should always be kept in mind. A horse should never be trusted more than is necessary. A good horseman never runs a risk when it can be avoided. Many distressing accidents occur from trusting old family horses. The harness and other equipment should be of good quality and in good repair. Children, women or incompetent men should never be left in charge of horses unless the animals are thoroughly acquainted with them. Horses should be tied about the neck by a strong rope or strap, the latter passed through the ring of the bit and then to the hitching-post.

Training colts.

There is far too much fuss made about training young horses. If the training is made a gradual process, it will be accomplished much as a matter of course. If, however, colts are allowed to run practically wild until three or four years old, and are then suddenly caught and an attempt made to force them into use quickly, there is likely to be more or less trouble. In training colts, often the mistake is made of trying to teach them too much at one time. The colt should understand his first lesson and have it thoroughly learned before another is attempted.

Perhaps the first lesson should be to "halter break" the young animal. A strong, well-fitting halter, not a new one, but one that has recently been used and therefore familiar to his sense of smell, should be placed on him, and he should be tied short near to his dam and in such a position that he cannot pull back too far or throw and choke himself. He must be tied securely so that there is no danger of his breaking loose, for if he breaks loose once he is likely to try it again. Colts should be treated gently but firmly. It is well to avoid making great pets of them, as petted animals are usually difficult to train.

After becoming familiar with the halter so that he will stand tied, he may be taught to lead (Fig. 436). If the method indicated is unavailable, the trainer may take a fairly long lead strap, get behind him and make him go ahead. The trainer should not stand in front and pull on the colt's head, for he will wall his eyes, shake his head and step back. It is a good practice to allow the colt to accompany his mother by tying the lead strap to her hame or collar; thus he becomes used to walking and trotting beside another horse.

Training to bit and harness.—It is perhaps best to train horses to the use of the bit and harness when they are about two years of age. With rare exceptions, the colt is made usable if for a few hours each day for a week he is subjected to the restraint of a bitting harness in an open paddock. This harness consists of an open bridle with a large,

smooth bit and check-rein, a surcingle and crupper, and two side-lines running from the bit to buckles on either side of the surcingle. (Fig. 437.) The check- and side-reins should be left slack at first.

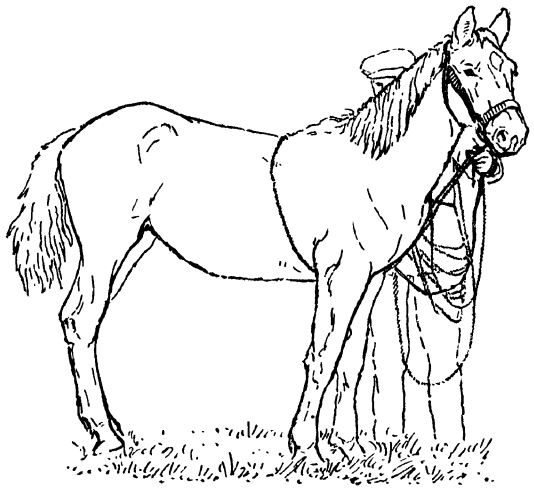


Fig. 436. A colt harnessed to be taught to lead.

Gradually, from day to day, the reins should be shortened, care being taken that they are never made so short as to place the head in an uncomfortable position, or draw the bit so tightly as to make the corners of the mouth sore. Real lines may now be substituted for the side-rein, and the colt driven around until he will respond to the rein, stop at the word "whoa" and step forward at the command "get up."

After the colt has become used to the bitting apparatus and to understand such simple commands as "whoa," "get up" and "steady," he may be harnessed. The colt should be trained to stand absolutely still when being harnessed, saddled, or when it is desired that he should do so. A horse that is continually stepping around while he is being harnessed, is but half broken at best. The attendant should be gentle about all these things at first, but should go through with everything that is undertaken. New harness should not be used, but that which has been in constant use, preferably by some horse that the colt knows.

After having been driven with the bitting apparatus for a time, and when the colt is rather tired, he should be put in his stall and the collar brought to him; he may smell of it if he likes, and then it should be put right on as if he were an old horse. The harness should be placed gently over his back. The attendant should not stand off as if the horse were a kicking cow; he should walk behind him, put the crupper strap on, then step to the side and fasten the bands. The horse is then ready to hitch to a vehicle.

Hitching double.— A well-trained, gentle but active horse should be taken if the colt is active, for it is a mistake to hitch a quick, active colt with a slow, lazy horse. The vehicle to which they are attached should be provided with a good brake. The colt should be attached to the "off-side," and they should be driven at first in a closed field until the colt learns what is wanted of him. When hitching the colt up double for the first time, it is a good practice to keep a pair of single lines on the colt's bridle, which can be handled by an assistant.

Hitching single.—When the colt is desired for single use, it is often advisable to train him to go single from the first. This may be done after he has become familiar with the bit, harness and use of the lines. A training cart for hitching colts single should be substantial, with long, heavy thills, and the seat arranged behind so that the driver can get off and on quickly. The colt should be hitched well forward. A strap, commonly called a kick-strap, attached to each thill and passed over the colt's croup, should always be used until the colt is accustomed to the thills. When the colt is first hitched up, an attendant should hold him until the driver is ready, then he should be allowed to go. As soon as he becomes familiar with the vehicle, he should be compelled to stand still until he is wanted to start.

Training to mount.— In training a colt to mount, one must be very careful that the colt does not succeed in throwing the trainer, for if he once gets the rider off, it is impossible to convince him that he cannot do it again. The best time to take the colt is after he has been exercised rather vigorously and while tired. The best place is on soft ground, where he can neither hurt himself nor the rider. The saddle is put on with the same confidence as the harness, and it is fastened securely. An assistant should hold the colt's head while the rider mounts. The horse may rear, bound forward, buck or lie down. In any event, the rider must stay on, remembering that the colt is already tired and on soft ground. It is often an endurance trial, and this is the reason why one must have the colt tired to begin with, for otherwise he may be able to

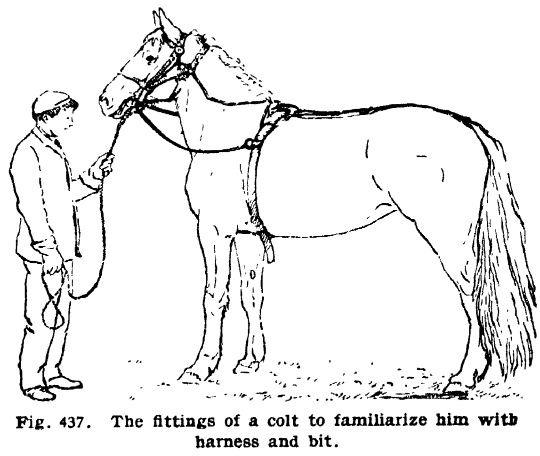


Fig. 437. The fittings of a colt to familiarize him with harness and bit.

bound and buck until the rider is so exhausted that he can no longer hold to the saddle.

Training vicious horses.

In training or handling vicious horses, it is most important to impress them very firmly that

the trainer has complete control over them and that they must obey him. The best way to impress this on the animal is to "rarey" him. The harness used for this consists of two short straps fitted with D-shaped rings, a surcingle and a long rope. The straps are buckled around the front pasterns, and the surcingle around the body. One end of the long rope is tied into the ring in the strap that goes around the pastern of the "near" front foot. The free end is then passed through a ring on the under side of the surcingle and then down through the ring at the other pastern. Then the rope end is brought up and passed through a ring, tied about half way down the "off" side of the surcingle. If the animal becomes unruly, all that is needed is to pull on the rope; this brings the front feet up to the chest and the animal comes down on his knees and nose. A few hard falls usually are sufficient for the most incorrigible. This is a very dangerous practice and should be undertaken only as a last resort. It sometimes happens that horses permanently injure their knees, or even break their necks as a result of a fall.

Balking.

Balking is the refusal on the part of the horse to do the work required when he fully understands what is wanted of him. It is often caused by improper handling, although sometimes by a vicious disposition. Balking is usually associated with nervous temperament, and all influences that tend to irritate the horse should be removed when possible. It is essential that the trainer be quiet and not lose his temper, as shouting, jerking and whipping only make matters worse. Often if the horse is allowed to stand quietly until the nervousness passes away, he will start of his own accord. Attracting his attention by adjusting the harness, giving him an apple, a bit of sugar, or by lifting the foot and gently pounding the shoe, will often overcome the difficulty.

Halter-pulling.

All horses that have this habit should be securely tied by a stout neck-strap or rope. Often they can be broken of the habit by placing a small rope, say one-quarter inch, around the body just back of the fore-legs, passing the rope between the fore-legs, then through the ring of the halter, and tie to the post. When the horse pulls back, the rope draws down on his back and he will usually cease. Another method is to tie one end of the small rope around the tail in the form of a crupper, the other end being passed along the back, through the halter-ring and to the post. When he pulls back, the force is exerted on the tail, and he soon stops.

Harnessing.

Good harness is one of the best advertisements a horseman can have. It is economical to buy good leather and then keep it in good condition. Harness oils and dressing are cheap and it does not take long to fix up a double set of harnesses. The metal parts should be kept bright and clean. There is considerable art in harnessing a horse just right. The harness, from the bridle to the crupper, should fit; that is, it should be neither too loose nor too tight. In harnessing, saddling or handling a horse, the work should be done from the left side of the animal, and the equipment fastened and unfastened from that side. In putting on the harness it should be gently but firmly placed on the animal. One should see that all loose flapping straps are avoided.

The collar is, perhaps, the most important part of the harness to be looked after. If the colt's shoulders are tender they are rather likely to show abrasions. In this case, the collar must be kept scrupulously clean and the shoulders may be bathed at morning, noon and night with cold salt water. If one is working a colt or a fleshy horse, he must be on guard to see that it does not lose flesh and the collar become too large. Breast-collars are admissable when the load is light. They must not be adjusted so high as to choke the horse or so low as to interfere with the action of his limbs.

Perhaps the bridle is the next important item. The length of the head-stall must be so adjusted as to bring the bit in mild contact with the bars of the mouth, so that the animal will respond quickly to the slightest pressure on the lines. If the head-stall of the bridle is too short, the bars and corners of the mouth soon become sore and the animal finally becomes unresponsive; on the other hand, if too long, the horse becomes careless of the driver's wishes. As to the advisability of using blinds, there is a great diversity of opinion. If the horse works better with an open bridle, it should be used; if better with a blind bridle, the blind should be used.

The check-rein should be properly adjusted. There are two kinds of check-reins, the over-draw and the side-rein. The over-draw, if worn tight, is nothing short of cruel; it makes the horse hold his head in an uncomfortable and unsightly position. If no check-rein is used, most horses become slovenly and careless in their habits. The crupper needs careful attention. It should fit and be kept clean, lest it abrade the tail and produce a vicious horse.

Driving.

Driving is an art that does not lend itself well to instruction by the medium of words. The indescribable qualities which, rightly commingled, make the good driver, cannot be acquired from books, but must, in a large measure, be born in the horseman. Study, observation and especially practice, will add to his ability, but all that may be written will not make one adept. The understanding between horse and driver is so keen that the horse is inspired with courage and obedience by the slightest touch on the reins or by the cheery voice of the driver. On the other hand, careless and lazy drivers are the source of far more disobedient horses than is generally supposed. Just as surely as the driver is shiftless, the horse will soon become so.

Position of the reins in driving.—The most convenient way to hold the lines when driving is to take them in the left hand, the left rein coming into the hand over the first finger, the right coming into the hand between the second and third fingers. The guiding is to be done with the right hand which manipulates the lines. The left arm should hang naturally, with the forearm at a right angle, and the elbow close to the body. This position gives the driver the best control over the lines, and at the same time is very comfortable.

Rules of the road.—There are a few common rules in practice that should be observed by every one when riding or driving on the highways. In general, when two vehicles meet, they should each turn to the right, each yielding more than one-half of the road. This rule applies, no matter where the vehicle may be. If, however, one of the vehicles is heavy laden and cannot yield one-half of the road, it must stop and let the lighter rig go around. It is the rule for the driver of the heavy laden vehicle to aid the driver of the lighter one to get around when such aid is needed. In some states, a pedestrian or a man on horse-back is entitled to half the road, the same as if he were in a carriage. If behind a vehicle, and it is desired to drive around, the rear vehicle should drive to the left. As a rule, the driver of the small moving vehicle will bear off to the right if signalled. However, he is under no obligations to do so in most states. When there are two worn tracks, or on the city streets, each driver is supposed to keep to the right track or curb, as the case may be.

Training saddle horses.

Classes of saddle horses.—In a discussion of the education of the saddle horse, it is well, perhaps, to mention briefly the different classes of saddle horses. There are four distinct classes: The plain-gaited, usually called the walk-trot-canter horse; the gaited saddle horse; the hunter; and the high-school horse. The *plain-gaited horse* is required to walk, trot and canter only, but he must do these few gaits very well or he is of little value as a saddler. The *gaited saddle horse* is required to go five gaits. He must walk, trot, canter and rack; and for the fifth he may choose any one of the three slow gaits, running-walk, slow pace and fox-trot. It often happens that he is able to go all three of these, which, in addition to the four that he must go, makes seven distinct and unmixed gaits. The *hunter* must go the walk, trot and canter, and in general, is similar to the plain-gaited saddler. However, in addition to the plain gaits, he must be able to hurdle—jump hurdles, fences, ditches and the like. The *high-school horse* is required to go the gaits of the gaited saddler and many others, some thirty-four in all.

The training of a saddle horse is an art that cannot be learned from books, but must, in a sense, be born in the man, or be learned at the school of practice and experience.

Walk.—We will start with the horse at the walk, as that is the foundation of all saddle gaits. The horse should be provided with a double-rein bridle with both curb- and snaffle-bits. When ready to start, the rider pulls up lightly on the snaffle-bit and urges him to the top of his speed at the flat-foot walk. The horse is held steady, and if he is a good walker, he should go four to five miles per hour.

Running-walk, fox-trot or slow pace.—The next step is the running-walk, fox-trot or slow pace. The snaffle-rein is loosened, the curb-reins are lightly drawn up and the animal is urged just out of a walk. These gaits are faster than the walk but slower than the rack. When well performed, they are delightful riding. Whichever of the three gaits the horse strikes, when urged out of the walk, he he should be held steady, and not allowed to forge ahead into a rack or trot, or fall back into a walk.

Rack.—The rack may be tried next. For this, a smooth, hard road is desirable, as it is a hard gait on the horse and if the road is soft or rough it will fatigue him. The rider increases the pressure on the curb-rein, grips the horse with the knees so that he will feel the clasp, and at the same time gently uses the spurs. A horse is taught to rack by spurring him forward and curbing him back. The rider must hold him steady and not let him fall into a side-wheel pace. If he falters, the spur is used lightly. The curb-reins are then slackened, the horse taught to slow down at the command "steady" and allowed to come to a walk.

Trot.—After the rack, the trot may be undertaken. The snaffle-reins are drawn up, letting the curb-reins hang free; some horsemen, however, prefer to execute the trot on the curb-reins rather than the snaffle-reins. The horse is urged forward, and as he starts off, the rider rises in the saddle. The horse should take the trot at once. If he does not, he is brought to the walk and again started. At the start some trainers reach forward and grasp the animal by the mane, well up the neck. Whatever signals are employed, the same signals should always be used for a given gait. When the horse strikes a square trot, he is held to it steady.

Canter.—The canter, the most graceful and enjoyable gait when perfectly performed, may next be tried. The horse is taken in hand, and pulled together until his legs are under him; the curb-rein is taken in lightly, the rider leans forward, urging him to move off quickly, and at the same time saluting him by raising the right hand so that he may see it. He should take the canter at once. If he does not, he is brought to a walk and again started. The moment he does strike the canter, he is held steady until the lesson is complete.

This code of signals is in ordinary use in the South, where riding is a popular pastime. All horses will not respond to these signals. The individuality of each animal must be worked out, and the trainer govern himself accordingly.

Position for riding.—Each of the saddle gaits requires a special position of the rider. All men are not of the same build and each must take a position to suit him. For these reasons and others, no specific rules can be laid down for the position of the rider. Only general directions can be given. The rider should sit in the middle of the saddle, resting his

weight on his buttocks; he should hold his body and head erect; shoulders well back; chest thrown slightly forward; left fore-arm horizontal, elbow close to body; right hand hanging naturally; thighs nearly parallel to the horse's shoulders, and in close contact with the horse's body, the lower part of the legs hanging naturally. The ball of the foot should rest on the tread of the stirrup, and the heels should be a little lower than the toe. The stirrup straps should both be of the same length and not so long as to render the tread insecure, or so short as to cramp the leg.

Position of reins when riding.—The most convenient way to hold the reins when riding is to take them in the left hand, the left curb-rein coming into the hand around the little finger, the right curb-rein between the first and second fingers; the left snaffle between the third and little fingers, and the right snaffle between the second and third fingers. Practical horsemen differ as to whether the curb-reins or the snaffle-reins should be on the inside. The guiding is to be done with the right hand, which manipulates the reins. The left arm should hang naturally, with the forearm at a right angle and the elbow close to the body. In this position one has the reins separate and under good control.

Literature.

For references, see pages 416 and 424.

Feeding the Horse.

By *Merritt W. Harper.*

One who studies the practices of successful horsemanship will become strongly impressed with the fact that there are many ways of securing the desired end, high finish and fine action, in the horse. If in any locality we study the rations in most common use, we will find them usually composed of only one or two kinds of grain and the same limited number of coarse dry fodders, the feeder insisting that this is the most practical and economical ration he can feed with safety. One need not travel far to find the list more or less changed, sometimes entirely so, yet with the same claim to superiority or necessity as before. In the northern states, the most common feeds for the horse are corn or oats for the grain, and clover or timothy hay for the roughage; in the West, crushed barley is the common grain, while the hay comes largely from the wild oat and barley plants; in the South, corn serves mainly for the concentrates, with dry corn leaves for the roughage. Thus it seems that each section is rather limited in the variety of foods composing the ration.

Horsemen in the northern states often state that, with plenty of sound oats and good timothy hay at hand, they care nothing for other food articles. While it is true that a horse can be maintained on this ration, and many race horses are fed no other food during their severe campaigns, yet it seems reasonable that equally good or better results might be obtained, and the cost of the ration often lessened, by feeding a ration containing more variety, especially for other types of horses than those of the race-course. If energy and spirited action were the only qualities desired in the horse, then, perhaps, oats and timothy hay might suffice; but when we take into account the number and complexity of the various organs in the body, we can well understand that these might be better nourished by several grains and forage plants than by a few. A ration is ordinarily considered well varied if it furnishes four different materials. The food should come from different plants; if possible, from different natural orders. A ration that is composed entirely of grasses and cereals would not afford the same variety to the animal as one in which leguminous foods were given in part.

The feeding system.

Whatever feeding-stuffs are employed in the ration, the horse should be fed regularly and uniformly at all times. He anticipates the feeding hour, and becomes nervous if it is delayed. His digestive system, his entire organism, becomes accustomed to a certain order which must obtain if one is to be successful. The digestive apparatus of the horse is not nearly so large relatively as that of the cow or sheep; he has no rumen, no place to store his food to be masticated at will; hence, when at work he must be fed regularly and often.

Successful horse-feeding differs much from that of most other domestic animals. Cattle, sheep and pigs are fed to produce gain in weight or, in the case of the milch cow and sheep, to produce body secretions in the form of milk and wool, whereas horses are fed almost exclusively as beasts of burden, whether the work consists in carrying a rider or in drawing a load. In late years, a new industry has sprung into existence, that of fattening horses for the market. This has become as much a regular business as feeding steers.

Because of the small size of the horse's stomach, the order of administering grain, hay and water assumes much importance. Colim's investigations on the stomach of the horse show that this organ must fill and empty itself two or three times for each feed given. From this experiment, it appears that during the fore part of the meal, the material is pushed, almost as soon as it enters the stomach, into the intestines by the food that follows; while toward the end of the meal, the passage is slow, and the digestion in the stomach is more perfect.

Marlot, conducting experiments in France, showed that if a horse is fed his grain first and then watered, much of the food is carried by the water into the intestines. Since the grain of the ration is rich in protein, it should stay in the stomach as long as possible, as the digestion of this nutrient is more complete there. Thus it would seem that the horse should be given water first, and that it should be followed by hay, the grain being withheld until at least a part of the hay has been consumed. There are, however, very serious objections to this practice, as the horse is unsatisfied and very nervous until fed his grain, and we should not make him wait for the grain until he has consumed the hay allowance. A middle ground may be taken by

watering first, feeding the grain, sprinkled with a small allowance of moistened chaffed hay, and watering again after the ration has been consumed. If this practice is followed, it will satisfy the desire of the horse by supplying the most palatable part of his food early, and yet insure the retention of the grain in the stomach for a considerable period.

Sanborn, studying the effects of watering before and after eating, reports in bulletin No. 9, Utah Agricultural Experiment Station, as follows: (1) Horses watered before feeding grain retained their weight better than when watered after feeding grain; (2) horses watered before feeding had the better appetites or ate the most; (3) horses watered after feeding grain, in ration of food eaten, seemed to digest it as well as those watered before feeding; (4) it seems advisable to water both before and after feeding.

When horses are taxed to the limit of their endurance, the preparation of the food should receive much attention. In this case all grains should be ground and sprinkled with moist chaffed hay when fed. Food thus prepared is more thoroughly and rapidly masticated. Long hay, of course, should be supplied the animal, to be consumed at leisure. As hay is always more or less dusty, it should be administered in such manner as to cause the horse the least annoyance. Moistening or sprinkling the hay with water is the simplest way to reduce this trouble to a minimum. Dusty hay should be avoided whenever possible.

Salt in limited quantities should be kept before the horse at all times. While little is known from investigation on this subject, it is evident from the extreme fondness of the horse for salt that it should be regularly supplied him. It is best not to place too much before him at a time, as some horses will eat it to excess.

The successful horseman will study each individual and modify the ration according to the needs of each: one horse should have a little more than the regular allowance, and the next possibly a little less, because some horses are more difficult to keep in condition than others doing the same work and under similar conditions.

In handling horses, we should remember that they are very sensitive animals and that we cannot be too quiet in our treatment of them. Striking them or shouting commands is a contemptible practice; it causes the animals to lose confidence in their master, thereby rendering them less teachable, and destroying nervous energy, making them less economical producers than if they were protected at all times from these nervous shocks.

Feeding the work horse.

The work horse has a hearty appetite, a vigorous digestion, and responds as does no other animal to intelligent care. He should be fed liberally and frequently, the amount given being regulated by the size of the animal as well as by the amount and kind of work he is required to do. In general, the horse should be supplied with something over two pounds of provender daily for each hundred pounds of weight. Of this, about two-thirds—the exact amount depending on the severity of the labor—should be grain in some form. If the work is exceedingly heavy, the grain in the ration should be increased and the hay diminished; if the work is light, the grain should be diminished and the hay increased. The morning meal should be comparatively light, and consist mostly of grain. It should not possess much bulk. In many of the larger stables, the midday meal is omitted. But most horsemen hold that some grain should be given at noon. In any case, the midday ration should not be large. The heavy feeding should come at night, after the day's work is over and when the animal has time to masticate and digest his food.

A very good practice is as follows: For the morning ration, feed one-fourth of the daily allowance at least one hour before going to work. It should be in condition to be consumed easily and rapidly, so as to be well out of the way when the animal is led from the stable. After being watered, he is ready for his morning's task. If the work is exhaustive and exacting, he should be fed after five hours of labor. When he comes to the stable at midday, he should have a drink of fresh, cool water, care being taken that he does not drink too rapidly or gorge himself if very warm. At this time give him another quarter of his daily allowance. No greater service can be rendered the horse at this time than removing the harness so that he can eat his meal in quiet and comfort, and gain a few moments of much needed rest. If possible, he should have one hour to consume his meal. He should be watered again before going to work. When the horse comes to the stable in the evening, tired and warm, he should be allowed, first of all, a fresh, cool drink, care being taken as before that he does not drink too rapidly. He is now ready for the remainder of his day's allowance. Unharness at once, and, when the sweat has dried, give him a thorough brushing. If, for some reason, the horse is forced to stand idle in the stable for a few days, the ration should be decreased. Otherwise he will become stocky, with his legs swollen and stiff.

In cold weather, a more carbonaceous ration may be used. When more food goes to furnish heat for the body, a horse needs a large proportion of heat-making food. Equal parts of corn and oats by weight would be more satisfactory and ordinarily much cheaper than a larger proportion of oats. Most farmers have much less work for the horse in winter than in summer. It is an excellent practice and much more economical to rough through the winter those not needed for work. Those reserved for work should have good care and be fed according to the amount and kind of work performed.

In providing a ration, whether for summer or winter use, due consideration should be given to cost. Roughage is ordinarily much cheaper than grain, but a horse at work is unable economically to dispose of a large quantity of bulky food. If considerable time and energy must be expended in masticating rough feed, the usefulness of the horse for work is lessened thereby. The more concen-

trated the food, within proper limits, the less energy will be needed to make it available. The proportion of grain to roughness depends on the amount and kind of work to be performed. A horse at hard work should never be expected to consume more roughage than grain by weight.

Feeding the driving horse.

The driving or carriage horse is more difficult to keep in condition than the work horse. The periods of enforced idleness, occasioned by lack of business engagements of his master, or because of inclement weather, are often followed by long drives and hours of over-exertion. This irregular work weakens the constitution of the driving horse, which generally has but a brief career. When daily driving cannot be practiced, underfeeding is considered the safest course.

In feeding this class of horses, the same general system that has been suggested for the work horse should be followed. When the horse is not taken from the stable during the day, the concentrates, or grain part of the ration, should at once be reduced by one-third, and the normal allowance should not again be given until work is resumed. Carriage horses are usually overfed, because of the desire of the owner to keep them in the pink of condition. This over-feeding and irregular exercise is the cause of most of the ills of driving horses. Oats easily lead among the grains ; when these are fed, the horse exhibits mettle as from no other food. If at any time the animal should seem constipated, a bran mash should be given. While a certain amount of roughness must be fed to give bulk or volume to the ration in order that the digestive functions may be maintained properly, yet we must remember that a large abdomen cannot be tolerated in the carriage horse. Again, the feeder of this class of horses must ever be on his guard against laxative foods, such as clover or alfalfa hay, or bran in too large quantities, for when the horse is put on the road and warmed up, it will prove very draining on his system as well as disagreeable to the driver. Style and action are generally considered prerequisites, while economy in feeding, and often the health of the animal, are but secondary.

Feeding the trotter.

In feeding the trotting horse, all must give way to the single requisite of speed. Every pound of useless weight, whether body weight or extra food, must be worked off, otherwise it will become a serious matter in the management of the trotting horse. More important than this, however, is the effect of the food on the character of the muscle formed from it, and especially on the nerve and mettle of the horse. As in the case of the driving horse, economy in the cost of the ration is not to be considered. Everything yields to speed.

When the campaign has closed, and the animal is taken into winter-quarters, the feed should be reduced by at least one-half. Good sound oats and clean, sweet timothy hay should constitute the bulk of the ration. At this time a few carrots may be given and a bran mash occasionally, for these are cooling in their nature, and have a tendency to reduce any feverish or inflammatory symptoms. Horses turned out to the field should be fed oats twice a day, as oats will keep the muscles hard and the mettle up. In the spring, when shedding, bran mash may be given more frequently to keep the bowels open. Flaxseed and linseed should seldom be given, as they are thought to be too laxative and cause too severe a shock on the system.

When the horse goes into training, the strength of the food must be increased, although but slowly at first. As the oats are increased, the horse will want less hay, but may at first have all he will consume. Later it may be necessary to limit the hay, in such case one should see that he does not eat the bedding. No carrots should be given now. The bran mash may be continued once or twice a week if there is any tendency to constipation ; otherwise, it may be best to dispense with the mash altogether. During the last days of training, or just before the coming trial, he should be put on his largest allowance of strong food. The various individuals differ so very much that no definite amount can be stated. It is at this time, when all eyes are centered on the trotter, that the skill of the feeder is appreciated.

Wintering idle horses.

On the average farm, most of the work comes during the growing season. We think it more economical and perhaps advisable that the idle horse be turned to a lot, if it affords some protection, to be roughed through the winter rather than to be confined closely in the barn. As winter comes on, these horses grow a heavy coat of hair, which affords them excellent protection. Such horses may be maintained wholly, or nearly so, on hay, straw or corn fodder, fed uncut, as they have time for masticating food, and their systems not being taxed by labor, they are able to subsist on food containing a large percentage of inert matter. We think it better to have the digestive tract of the idle horse well distended with coarse material rather than concentrated, as would be the case if grains possessing only the requisite nutrients were supplied. If the protected area is kept dry and well bedded, horses can be wintered comfortably in this way at much less expense than by stabling. Light grain-feeding, together with some work, should begin six weeks before the spring work starts, to put the horses in condition for the spring work.

Feeding the brood mare.

Many farmers are situated so that they may raise a team of colts each year, without seriously interfering with farm operations. This is a very good practice, as there is a great demand for good horses for both city and farm purposes. A team of mares in foal can be worked until the day of foaling, if the work is not too severe and the driver careful. In fact, moderate exercise is necessary for the mare in foal. Idleness is the bane of horse-rearing and should be avoided whenever possible.

The Arabs have a saying, "rest and fat are the greatest enemies of the horse."

Mares in foal should be fed much as suggested for the work horse, with perhaps the addition of more protein foods, as bran and oil-meal, as such foods, rich in protein and mineral matter, are valuable for mares carrying foals. If the mare is constipated, bran mash may be given occasionally. Through the use of proper food, the bowels should be kept in good condition, and should be a little loose rather than otherwise at the time of parturition. While the mare may be worked up to the time of foaling, she should be given several days of rest after foaling to enable her to gain her strength and give the foal the proper start. For the first few days of recuperation, a hot bran mash fed once a day has both a cooling and a laxative effect on the mare, which is very beneficial. If all has gone well with the mare and foal, the mare may be put to work at the end of one week from the time of parturition.

Some dams, especially those with their first foals, fail to supply the proper amount of milk, and the young fail to make satisfactory growth, in which case the mare should be provided with food that stimulates the milk flow; good pasture grass is best, of course, but oats or wheat bran, with an equal weight of corn-and-cob meal, will often prove very beneficial. If there is an oversupply of milk, or if the milk is too rich, the food supply may be restricted.

Feeding the foal.

Very soon after birth, the foal should take a good draft of the colostrum, or first milk of the dam. Colostrum milk possesses purgative qualities which tend to discharge from the alimentary tract the fecal matters collected therein during fetal life. If this result is not accomplished, a small dose of castor-oil should be given the foal. With the bowels clean, the foal is ready to begin his career, and his treatment the first year will go far towards determining whether for good or bad. If the foal is obtaining an oversupply of milk, he will have an attack of diarrhea. In such case, some of the dam's milk should be drawn, remembering always that the last milk carries the most fat, which is usually the cause of the trouble. Diarrhea, whatever its cause, should be checked at once. Parched flour, rice-meal gruel, boiled milk and whites of raw eggs, are all excellent for this ailment. If the food is constipative, relief may be had by the use of castor-oil and by injections of warm water to which soap has been added.

Some farmers make a practice of permitting the foal to go to the fields with the team, while others prefer to keep the foal in the stable. During the first few weeks, the foal should be fed oftener than three times per day. For this reason it is better in the field with the dam if no inconvenience is caused. When older, however, the colt may be kept in the barn and given nourishment when the dam comes from work. If this method is practiced, the driver should be careful about letting the colt to the dam when the latter is very tired and warm.

It is well to encourage colts to take nourishment other than that supplied by the dam. This supplementary feeding may begin when the colt is about two months old. By placing the feed-box from which the dam eats her grain, a little raised from the ground, the colt will early begin to nibble from the mother's supply, and soon acquire a taste for grain. In this way the colt may be taught to eat, with the result that, when taken away from the dam at weaning time, it does not miss its mother so much. If eating well at the age of five or six months, the colt may be weaned without as much shrinkage as when unaccustomed to eating grain.

Growing colts should have more protein than is required for the work horse. No definite rules can be given that will apply to all colts. Oats, shorts, peas and perhaps some corn, may constitute the grain. Alfalfa, clover and mixed hays, which should be sweet and clean, may constitute the roughness. Colts suffer at times from teething, and to subsist wholly on hard, dry food, may cause them to run down in flesh. At this time, if one can steam the crushed oats or bran, they will prove appetizing and very nourishing. The first winter after weaning is the most severe on the colt, and he should receive much attention. The "big-belly," which is often noticed at this period, is nothing to its harm, for it is important that the digestive tract be developed to a moderate extent by distention with coarse feed, that it may serve its purpose when the animal is grown. At this period, the colt must have an abundance of outdoor exercise. There is no more certain way of ruining a colt than by liberal feeding and close confinement.

Occasionally something happens to the dam and the foal must be reared by hand or perish. Cow's milk, if modified with at least one-fourth its volume of water, together with some sugar, makes a fair substitute for the mare's milk, but should be given at about the same temperature as the dam's milk. Gruels made by boiling beans or peas, and removing the skins by pressing the pulp through a sieve, or oil-meal and shorts made into a jelly by boiling, are excellent for the motherless colt.

Henry says that a fair grain allowance for the colt, measured in oats, is as follows: Up to one year of age, two to three pounds ; one to two years of age, four to five pounds ; two to three years of age, seven to eight pounds.

Feeding the stallion.

The object in the management of a stallion is so to feed, groom and exercise him as to keep the horse up to the very highest possible strength and vigor. Very many owners endeavor to have the stallion in fine show condition by the time the season opens. The horse is not given sufficient exercise, is kept closely blanketed and fed various drugs, nostrums and condimental stock-foods ; he is loaded with fat ; his muscles becomes soft and flabby, and although he may seem to be in the very pink of condition, he is in reality not nearly so well fitted for service in the stud as he would have been if he had been fed on plain food, and given an abundance of exercise each day.

During the breeding season, the grain ration should consist mainly of good, sound oats; but this should be varied from time to time by a ration of corn, corn-and-cob meal, or perhaps barley. Wheat-bran is a valuable adjunct to the ration, and should never be dispensed with. It is rich in protein,—an especially important element of nutrition for the stud,—and is the cheapest, safest and best of all regulators for the bowels. The roughness should consist of sweet clean hay, such as timothy or timothy and clover mixed.

No specific directions as to quantity of food can be given. Some horses will require twice as much as others. As a rule, it will be safe to feed as much as the horse will eat with apparent relish; and if he be given plenty of exercise he will not become too fat. The fact should be kept in mind that anything that adds to the health, strength and vigor of the horse will increase his reproductive powers, simply because the sexual organs will partake of the general tone of the system; and whatever tends to impair the health and vigor will have its effect on the sexual organs as well. A horse in good condition needs nothing but sweet sound food administered regularly, pure air and plenty of exercise.

After the close of the season, the stallion should receive no mares; if permitted to serve a mare occasionally he will be nervous and anxious, requiring the same attention as in the height of the season. When possible, he should be turned into a small pasture lot, securely fenced, adjoining his stall, and the door left open at all times except in extremely cold or stormy weather. If the lot affords sufficient grass, no other food need be given. At the approach of winter, when the grass begins to fail, he may be given a limited feed of grain each day, and all of the hay or corn stover that he will clean up nicely. In this way a stallion can be brought through the winter in an economical and satisfactory manner.

Feeding horses for market.

In certain parts of the country, feeding horses for the market has become as much a regular business as feeding steers. As in beef cattle, quality and fat go together in determining the price of the horse. Provided the horse is sound, it is hardly possible to get him so fat that buyers will object for that reason. We have said that excessive fattening, with little exercise, lessens the future usefulness of the horse. But the shrewd business man proposes to meet the demands of the market.

The methods practiced in various parts of the country differ widely, as do the foods used. One large firm is now feeding twice daily of mixed feed,—bran, shorts and oats,—and once of corn, with good clover hay. The general rule stated in the fore part of this article, that a horse should be provided with something over two pounds of provender, of which one-half to two-thirds should be grain, for each hundred pounds of weight, and that the animal should have plenty of exercise, fails completely in this method of feeding, as the animals are fed all they will consume and kept closely stabled and blanketed, with frequently no exercise whatever. As a substitute for exercise, in order to keep the blood in good order, thus preventing stock-legs, glauber salts are often used. If mixed with oats or bran, the horse consumes them readily. These salts are fed once or twice a week. It is said that the salts aid in fattening and that they give the skin a soft, mellow touch. The average feeding period is ninety to one hundred days, and an average gain of three pounds per day is satisfactory.

Feeding rations.

Henry, in his "Feeds and Feeding," gives the following rations, from various sources, as a guide in determining the amount of feed that should be allowed the horse under various conditions:

Character of animal and work required	Ration	
	Concentrates	Roughage
Trotting horse.—(Woodruff.)		
Colt, weaning time	2 pounds oats	Hay ad lib.
Colt, one year old	4 pounds oats	Hay ad lib.
Colt, two years old	6 pounds oats	Hay ad lib.
Colt, two years old, in training	8 pounds oats	Hay, allowance limited
Colt, three years old, in training	8–12 pounds oats	Hay, allowance limited
Trotting horse.—(Splan.)		
Horse on circuit	10 pounds oats	Hay, fair amount
Horse on circuit	15 pounds oats, in exceptional cases (as with Rarus)	Hay, fair amount
Horse variously used.—(Stonehenge.)		
Race horse	15 pounds oats	6–8 pounds hay
Hack	8 pounds oats	12 pounds hay
Horse variously used.—(Fleming.)		
Pony	4 pounds oats	Hay, moderate allowance
Hunter, small	12 pounds oats	12 pounds hay
Hunter, large	16 pounds oats	10 pounds hay
Carriage, light work	10 pounds oats	12 pounds hay
The draft horse.—(Sidney.)		
Heavy, hard work	13 pounds oats 6 pounds beans 3 pounds corn	15 pounds chaffed clover hay
Farm horse.—(Settegast.)		
Light work	6–10 pounds oats	6–9 pounds hay 3 pounds straw
Medium work	10 pounds oats	10 pounds hay 3 pounds straw
Heavy work	13 pounds oats	12 pounds hay 3 pounds straw

Literature.

Literature consulted in the preparation of this article was as follows: Hayes, Stable Management; Henry, Feeds and Feeding; Smith, Profitable Stock Feeding; Sanders, Horse Breeding; Woodruff, Trotting Horses in America; Report of the Kansas State Board of Agriculture, 1899; Principles of Horse Feeding, Farmers' Bulletin No. 170, United States Department of Agriculture; Feeding Farm Horses and Mules, Bulletin No. 189, North Carolina Agricultural Experiment Station; Feeding Horses and Mules, Bulletin No. 72, Florida Agricultural Experiment Station; Feeding Colts, Bulletin No. 18, Iowa Agricultural Experiment Station; Horse Feeding, Bulletin No. 92, New Jersey Agricultural Experiment Station; Experiment Station Record.

Determining the Age of Horses. Figs. 438–449.

By *H. H. Wing.*

The age of the horse is an important factor in determining his present and prospective value. Familiarity with the characters that most certainly indicate age are, therefore, often extremely useful. A knowledge of these characters is not difficult to secure, but skill in their application depends much on familiarity and continued practice.

General considerations.

In estimating the age of the horse, the teeth furnish the best index, yet there are other general considerations that play an important part, especially in the case of young and very old animals. In very old horses, white hairs make their appearance around the temple, the eyes, the nostrils, and elsewhere; the poll or top of the head becomes more pointed, the sides of the face more depressed, the supra-orbits hollowed out; the back-bone becomes more prominent and often strongly curved downward, and the animal does not stand squarely on his legs, which show more wear. The lower jaws will be found much sharper in old animals than in young, because the teeth are so much more deeply incased in the alveoli in young animals. Little by little the teeth are pushed from their sockets in order to compensate for the loss occasioned by the friction of mastication, and at the same time the two borders of the lower jaw-bone are drawn toward each other. Another general indication is the appearance of knots or nodes on the side of the tail. These nodes are nothing more than prominences formed by the withering away of the flesh, thus leaving the transverse processes of the first coccygeal vertebra prominent. The first pair of these nodes should appear between thirteen and fourteen years of age; the second should make its appearance between the sixteenth and seventeenth years; and the third at about twenty-one years of age. Bear in mind, these considerations are general and to be considered as a whole: each, alone, is of very little or no use.

Examination of the teeth.

While differences in the appearance of the teeth are considered the most important and the most accurate means of estimating the age of domestic animals, and are the means employed by all horsemen, yet these are not absolutely accurate, and much depends on conditions as well as on the individuality of the animal. The teeth of horses that have bones of a somewhat open structure, are likely to indicate that the horses are older than they really are; while the teeth of horses whose bones are of fine, close texture, may indicate them to be younger than they are. Again, a horse fed on soft and succulent food is likely to show a young mouth, whereas one fed on hard, dry food is likely to show an older mouth. Thus, it is apparent that the texture of the bones, the breeding, the kind of food the horse has eaten, and other conditions, have more or less influence on the teeth.

The horse when full grown has forty teeth, twenty on either jaw, divided as follows: six incisors, two canines, one on either side, and twelve molars, six on either side. Since only the incisor or nipper teeth are inspected in estimating the age, they alone will be considered. It is the order in which they make their appearance that enables us to estimate the age up to five years, and the manner in which their surface is worn that aids us in the estimation from five to eight years of age. After the horse has passed the eighth year, it is sometimes difficult to determine his true age by the teeth. Those who are familiar with the method and in practice may come within a year or two of it until the horse becomes very old, when he may be said to be twelve or fifteen years past, for example, but how much past cannot be told with any degree of accuracy.

The colt.—Since one is seldom called on to estimate the age of a colt under two and one-half or three years old, we will hasten over the earlier period rapidly by simply pointing out the condition of the teeth at one year of age. The colt is provided before the end of the first year with a set of temporary or milk teeth. The difference in size of the jaw-bone between the foal and the grown horse makes a change from milk to permanent teeth necessary. During the first month after the colt is foaled, the temporary incisors make their appearance, the first or middle pair appearing at about one week of age; the second or intermediate pair, at one week to two weeks of age, and the third or lateral pair appearing at about one month of age. When these teeth appear it will be noticed that they are long from right to left and have well-defined cups. The edges gradually wear down so that by the time the colt is at the full age of one year, the marks in the central incisors will be much shallower and fainter than they were at first. All of the incisors will be up and the corner ones will be worn level. It requires much care to determine accurately the age of a colt after it has passed the first year and up to the time the central incisors are replaced by the permanent ones, which will be when the animal is two and one-half to three years of age.

When the colt is shedding teeth, its mouth should be closely watched, and if the milk teeth have not disappeared when the permanent ones have pushed

through, they should be removed, as they only serve to irritate the gums and to prevent the animal consuming the proper amount of food. At this time a little extra food, such as moist cut hay or carrots, will greatly benefit the colt.

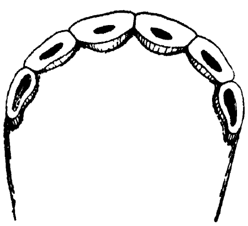


Fig. 438. The lower nippers of the colt at two years old.

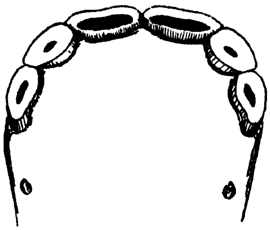


Fig. 439. Lower nippers at three years of age.

Two and one-half to three years old.—At about two years and nine months to two years and eleven months the central permanent incisors will appear, and at full three years of age the outer part of the teeth and sometimes the inner, also, will be up and in wear. (Fig. 439.) The permanent incisors are larger in every way than the temporary or milk teeth. By this age, the intermediate temporary incisors have worn down and lost all or nearly all their cups. There will be a slight black indentation that can hardly be called a cup. In the lateral or corner teeth, the cups are greatly reduced. If the colt be a male, small caps are likely to be present or in the process of coming through the skin of the jaw. These are called tusks.

Four years old.—At about three years and nine months, the intermediate incisors appear. At four years of age, they are fully up and in wear on the outside, and sometimes on the inside. (Fig. 440.) The central incisors show one year's wear, and the cups are not so deep as they were when the colt was three years old. The cups have nearly or quite disappeared from the lateral or corner temporary incisors, often nothing but a slight dark indentation being left. The tusks, if any, have enlarged, but are still sharp at their points and flattish on the inside. A side view of a four-year old mouth is shown in Fig. 441. Note that the crowns of the two temporary or milk teeth, one upper and one lower, come together closely over their entire surface, while the two permanent teeth do not meet at their posterior corners.

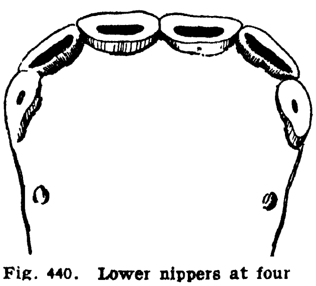


Fig. 440. Lower nippers at four years of age.

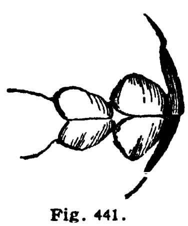


Fig. 441. Side view of the teeth of a four-year-old horse.

Five years old.—At the age of about four years and nine months, the permanent corner incisors make their appearance. (Fig. 442.) When the horse is full five years of age, the outer exterior parts of the teeth meet (Fig. 443), although almost one year of wear must take place before the lateral or corner teeth are worn level over their entire surface. At five years of age, the horse has a full mouth, and the central incisors have two years' wear. They have also changed slightly in shape, having become rounder on the inside. The intermediate incisors show one year's wear. The cups show in all, but are deepest and freshest in appearance in the corner teeth. In about one year more they will disappear from the central incisors, and in two years from the intermediate incisors. The tusks have enlarged, but are not yet blunt.

Six years old.—At six years old, the cups in the lower jaw have disappeared, or nearly so, from the central incisors, have become smaller in the intermediates, and the corner teeth are up and in full wear over their entire surface. (Figs. 444, 445.) Sometimes, however, a horse has "shelly" teeth, in which case the inside corner teeth may not be up and in wear; in fact, they may never come up, but always have the appearance of corner teeth that are not fully up. The center incisors have made marked changes in shape, becoming roundish on the inside, and the intermediates are also somewhat modified. If the horse's lips are parted and the mouth viewed from the front, it will be noted that the central ones will appear much darker colored and longer than they did at three or four. This is due to the shrinking or receding of the gums. In this connection, compare Figs. 439, 440, 442.

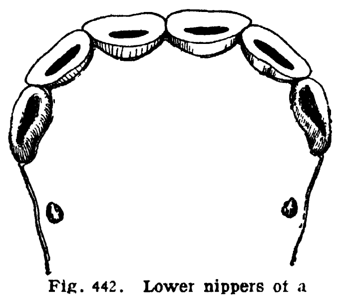


Fig. 442. Lower nippers of a five-year-old horse.

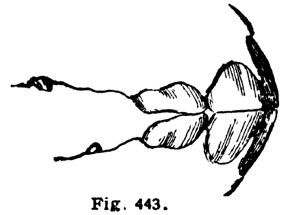


Fig. 443. Side view of the teeth of a five-year-old horse.

Seven years old.—At seven years of age, the cups in the lower jaw have disappeared from the intermediate incisors, although small dark spots may often be seen. The corner teeth still retain their cups, although they are rather shallow. It is well to bear in mind that, from the time when the teeth in the lower jaw are well up and in wear to the time the cups have disappeared in the lower jaw, is three years. The teeth in the upper jaw retain their cups a much longer time,—in fact, just twice as long, disappearing in six years from the time they made their appearance.

A side view of a seven-year-old mouth shows one marked characteristic. The lower corner teeth seldom extend as far backward as the upper ones. (Fig. 446.) Only in rare cases do all four corner teeth meet accurately. The result is that the face of the tooth in the rear recedes, while that part of

the tooth not in wear projects downward, forming more or less of a notch.

Eight years old.—At eight years of age, the cups have disappeared from the teeth in the lower jaw. One must not be misled by the slight dark-colored indentations that are still present, for they are not deep enough to be called cups. (Fig. 447.) The shape of the teeth has undergone marked changes. (Compare Fig. 439 with Fig. 447.) In the first place, the teeth were thin from outside to inside, and comparatively broad from right to left, while in the latter case they are much thicker from inside to outside—they have become more triangular in shape. If viewed from the side, they will appear somewhat longer and will meet at a sharper angle than they did when the horse was younger. As age advances, the angle of the teeth decreases. At three years of age, the upper and the lower teeth meet nearly vertical with each other, while at twenty they meet at an angle of only 45°.

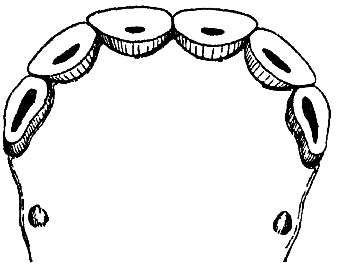


Fig. 444. Lower nippers of a six-year-old horse.

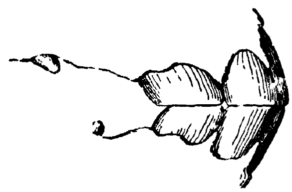


Fig. 445. Side view of the teeth of a six-year-old horse

Nine years old.—At nine years of age, the cups will have disappeared from the upper central incisors, and be shallow in the intermediate, and fairly deep in the corners. The cups are not likely to disappear at as regular intervals in the upper jaw as they did in the lower. Therefore, it is not always possible to tell the age of the horse within a year or two after he has passed his eighth year. Horses with soft bones may show a mouth older than they really are, while those with hard dense bones may show a mouth younger than they are.

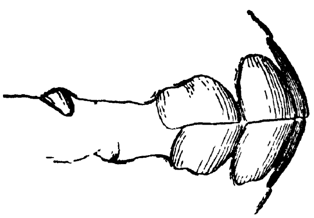


Fig. 446. Side view of the nippers of a seven-year-old horse.

Ten years old.—At ten years of age, the cups have disappeared from the upper intermediates, but are still in the corners, although shallow. The teeth are more triangular in shape, and those of the upper and lower jaw meet at a sharper angle as the age increases.

Eleven years old.—At eleven years of age, the cups have all disappeared from the upper jaw. However, because of the fact that some animals have denser bones than others, it is not uncommon to find shallow cups in the upper corner teeth as late as the twelfth or the fifteenth year. The shape and angle of the incisors will enable a close judge not to be much deceived.

After the horse has passed the twelfth year, the matter of two or three years amounts to little. Much depends on the individuality of the animal, as some animals are worth more at eighteen years than others are at fourteen. One's judgment of the value of a horse at these ages should be formed on general appearances and activities, rather than on age, which cannot be accurately determined by an examination of the teeth. One may distinguish between a horse that is moderately old and one that is very old, but after the horse has reached his eighth year, the teeth do not accurately indicate his age.

In old horses, the incisor teeth have become nearly triangular, and they show long wear. The tusks are large, blunt and round; the front ends of the teeth have been broken off, and they meet at an acute angle. These differences are well illustrated in Figs. 448, 449. The teeth may have grown out so long as to prevent the double teeth from meeting, in which case the horse will spit out his food after he has masticated a part of it. If the incisors are rasped off on their posterior edges, the grinders will then meet and life will be somewhat prolonged.

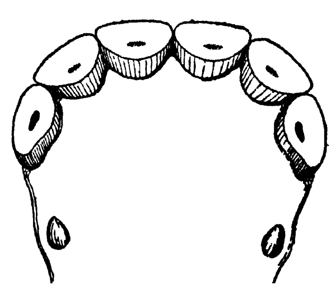


Fig. 447. The lower incisor, or nipper teeth, of an eight-year-old horse.

Irregularities in teeth.—Thus far we have considered the teeth as regular. It often happens that the teeth are not regular. When these irregularities exist, the horse is said to have a false mouth. While many of the irregularities are without importance, there are certain others which should be taken into consideration. They are important in their physiological relations as well as in estimating age. These irregularities occur in the number: there may be more or less than the regular number — thirty-six in mares, or forty in horses. Or, the irregularities may occur in the form of the incisors or through the uniting of two incisors; they may occur because one jaw happens to be longer or shorter than the other; they may occur as a result of

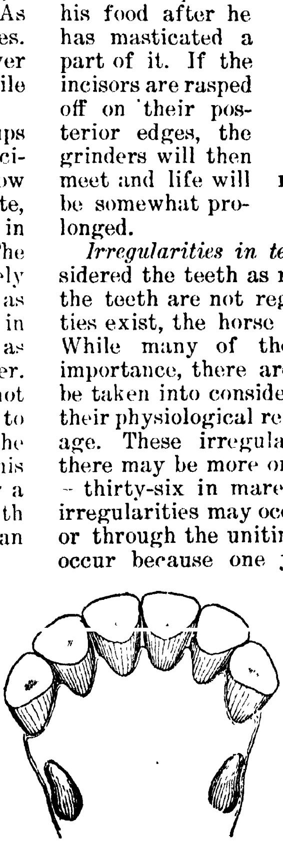


Fig. 448. The lower incisor teeth of an old horse.

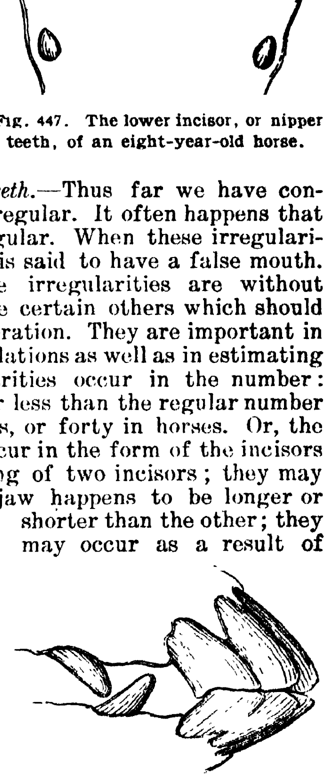


Fig. 449. A side view of the nippers of an old horse.

cribbing—some horses have the bad habit of biting the stall fixtures or other surrounding objects, thus breaking off the free borders of the teeth, which make the teeth irregular and which must not be confused with normal wear. Such cases can usually be recognized by the broken-off particles and the roughed surface. Then, again, irregularities may result from the employment of fraudulent means, the horseman striving to give the mouth the characteristics of that period of life in which the animals have their greatest value, and endeavoring to make the young appear old and the old appear young. It is ordinarily easy to detect a mouth that has been tampered with. If the abnormal wear has been produced by a file, the marks of the latter can be seen on the teeth. If, after having made a surface artificially, the latter be polished to remove the marks, the fraud can be detected by the fact that the enamel is just on a level with the dentine.

After the teeth have once been tampered with, they no longer serve as an index in estimating age. The dental tables, the cups and the like, have in most cases been partly or wholly destroyed. A person estimating the age of such animals must rely on general indications, such as gray hairs about the temple, eyes, nostrils; the pointed poll; the depressed face; the sunken supra-orbits; the prominent back-bone; the sway back; the sharp lower jaw; the nodes in the tail, and the angle at which the teeth in the upper and lower jaws meet, as well as the shape of the teeth, which, as we have pointed out, become more triangular as the animal advances in age.

Literature.

Much attention and study has been given to the question of estimating the ages of horses by their dentition, and discussions of the methods will be found in many books devoted to the horse. Mention is made here of two works in which the subject is discussed carefully: Gaubaux and Barrier, The Exterior of the Horse, translated by S. J. J. Harger, J. B. Lippincott Company, Philadelphia; Roberts, The Horse, Macmillan Company, New York. [For further references, see page 416.]

Common Ailments of Horses. Figs. 450–459.

By *John R. Mohler* and *George H. Hart.*

In this article only the sporadic or non-infectious diseases of horses will be discussed, together with the best-known methods of treatment. Diseases of this class affect only one or two animals in a stable at one time, and do not spread through a stable or herd from one animal to another. As was noted under the ailments of cattle, in many cases it is advisable to employ a veterinarian to treat ailing animals, as the slightest carelessness or misjudgment may result fatally. While it is highly desirable for the farmer to be able to diagnose the ailments of his stock, and to be able to treat the less serious disabilities, he will generally find it to his advantage to employ skilled assistance for cases which may involve the life of the animal or which are liable to produce much suffering. It is well to be on the safe side.

Temperature.

In order to restore diseased animals to health, it is necessary to know the character of the disease affecting them. It follows that the ability to make a correct diagnosis is the fundamental principle on which the treatment of the disease is based. In the domesticated animals, we are unable to obtain knowledge directly from the patient, as to where the trouble is located; and, therefore, we are compelled to make a diagnosis, by carefully noting the symptoms produced. Among the more important symptoms that will be referred to frequently in discussing the following diseases, are abnormal temperatures, pulse rates and respiratory movements.

In the first place, a knowledge of the temperature of an animal assists in making a diagnosis; second, it keeps one posted as to how the case is progressing; third, in some diseases, as influenza, swine plague and Texas fever, it is the first symptom denoting the approach of the disease. The normal temperature of the various animals is as follows [See also page 21]:

Horse	99.5° to 101.3° Fahr.
Ox	100.4° to 102.2° Fahr.
Sheep	102.2° to 104° Fahr.
Hog	100.4° to 104° Fahr.
Dog	99.5° to 102.2° Fahr.

In order to ascertain the temperature, it is necessary to be provided with an ordinary clinical thermometer. The end to be inserted should be covered with vaseline or lard. It is placed in the rectum for three to five minutes. Accompanying fever there are always chills, an increase in the number of heart-beats per minute, loss of appetite and general nervous depression. Care should be taken not to miscalculate the reading of a high temperature in the horse after the animal has been doing heavy work on a warm day, or in other animals when they become greatly excited during the taking of the temperature. In horses, the temperature, even in most severe diseases, rarely passes 107° Fahr., except in cases of heat stroke, when it has been known to reach 110° Fahr. The highest normal temperatures are always recorded in the afternoon, and the lowest in the morning.

A subnormal temperature is rare in diseases of animals. The most striking and constant example of this is seen in milk-fever in the cow. Sometimes a subnormal temperature is recorded in cases when the thermometer has not been inserted far enough, or when the passing of feces has taken place just prior to the taking of the temperature, both of which conditions should be carefully guarded against.

Pulse.

The average normal pulse frequency in animals is as follows [See also page 21]:

Horse, 28 to 40	Sheep, 70 to 90
Mule, 45 to 50	Swine, 60 to 100
Cattle, 40 to 80	Dogs, 60 to 120

In disease, the character, frequency and regularity of the pulse may be altered. It is usually increased in frequency, although in chronic brain troubles a reduction in the number of beats per minute may be observed. In all febrile diseases, and in severe hemorrhages, the number of beats per minute serves to guide one in judging the strength of the heart. When the pulse of the horse exceeds 100 per minute, the chances of recovery are very slight. By the regularity of the pulse is meant the following of the beats in regular order with the same period of time elapsing between them. In an irregular pulse, a beat is dropped now and then, or an extra one may be counted in. An irregular pulse is seen normally in dogs, and occurs also in horses when the pulse is very high during the course of febrile diseases.

Respiration.

The frequency of respiratory movements per minute in animals is as follows [See also page 21]:

Horse,	8 to 16	Swine,	10 to 20
Ox,	10 to 30	Dog,	10 to 30
Sheep,	12 to 20	Goat,	12 to 20

Normally, respiration is noiseless, although at times fat cattle may grunt after feeding; and lively horses and cattle may snort when startled. In disease, various sounds may be heard, among the more important of which is the wheezing sound from the nose, caused by a narrowing of this region, due to tumors or enlargements of the bone. A rattling sound comes from the region of the throat when the vocal cords are relaxed, as is heard in sore throat. The most important respiratory sound, perhaps, comes from the larynx and generally is increased in volume by violent exercise. It is heard in horses affected with what is commonly known as "roaring," and varies in pitch from a whistling to a roaring tone. Groaning is heard when expiration is attempted through a partially closed voice-box, and also in painful diseases affecting the chest, as pneumonia and pleurisy.

Urticaria or hives.

Urticaria, also called nettle rash or hives, is an affection of horses and other animals resulting from a number of causes, and characterized by the eruption of various-sized swellings (wheals) on the skin. The disease is most common in young animals in good condition. It occurs usually in the spring, during rainy, muggy weather, with high humidity. Not infrequently cases occur without any ascertainable cause.

In the majority of instances, the disease is the direct result of some digestive disorders; and certain foods, as buckwheat, new oats, green potatoes, are especially liable to produce the eruption. Such disorders, however, are followed by urticaria in a very small percentage of cases, and consequently some co-existing condition is necessary, which is thought to be some abnormal irritability of the nerves supplying the blood-vessels in the skin.

The disease is peculiar in the suddenness of its onset. The owner's attention is attracted to the animal by the swellings on the skin, which spread with great rapidity, and in a few hours may be generally scattered over the body. They vary in size from a half-inch to two inches in diameter; and in some cases, several may become confluent and the resulting swelling attain the size of a dinner-plate. The edges of the swellings are cut off sharply from the surrounding tissues. They are supposed to be due to a spasm of the blood-vessel walls, with rapid leakage of blood serum therefrom, being therefore localized edematous infiltrations of the skin. The eruption is also accompanied with marked itching, but there is no tendency to rupture or to suppuration.

The disease is usually without fever and of short duration, often entirely disappearing after one or two days. Such animals, however, are liable to subsequent attacks.

Treatment. Food should be withheld for twenty-four hours, after which bran mashes and small quantities of hay may be given. The digestive tract should be evacuated by the administration of a quart of linseed oil or one and one-half pounds of Epsom salts. The local application of alkaline solutions, as one tablespoonful of sodium bicarbonate to a quart of water, or a weak solution of ammonia, will relieve the itching. Recovery is rapid, and the swelling usually disappears in a few hours to two days.

Heat-stroke.

This is a condition seen principally in horses, but also at times affecting cattle and sheep on long drives. It is due to excessive heating of the entire body, thereby differing from sun-stroke, which is due to the direct action of the sun's rays on the head and is rare in animals. Heat-stroke is seen only in the hot summer months and usually affects draft horses. The attack comes on much more gradually than in sun-stroke. The animal stops sweating, appears droopy in the harness, drags along for a short distance, but soon goes down and becomes unconscious. The breathing is rapid and shallow, the pulse rapid and weak, and the body temperature excessively high, sometimes reaching 110° or 111° Fahr.

Treatment. The treatment must be very energetic and directed toward the immediate reduction of bodily temperature, as the animal can stand this excessively high temperature only for a very short time, if he is to recover. Ice-bags should be applied to the head and cold water poured over the body from buckets or, better, from a hose. This will reduce the temperature of the skin, but at the same time, it is essential to stimulate the weak heart in order to increase circulation, and especially the circulation in the skin where heat-radiation takes place. For this purpose, one-half pint of whiskey should be given immediately, followed by tincture of digitalis in one-dram doses by the mouth, or one-half-dram doses subcutaneously. In the latter method of administration, the action is quicker. The cold water should be continued until the temperature is reduced to 102° to 103° Fahr., when it should be withheld and applied again only

in case the temperature rises. The limbs should be rubbed briskly with straw or the hands. Bleeding an animal affected with heat-stroke is a very bad practice and should always be discouraged. Recovery is gradual and is prolonged over a week or two, during which time the animal should have general tonic treatment and be returned to heavy work gradually.

Periodic ophthalmia (Moon blindness).

Moon blindness is an ailment affecting the horse alone of all the domestic animals. It is an inflammation of the interior of the eyeball, usually affecting only one eye at a time, one attack of which is almost sure to be followed by subsequent ones, and leading eventually to complete loss of sight.

The exact cause of this disease is unknown. Various parasites have been said to be instrumental in its production, but none has been proved to have a direct causative effect. However, it is especially common in damp, marshy soils and seems to be especially prevalent after wet seasons. Heredity is also supposed to play some part in its production. This, however, is not positive, as foals from affected dams or sires, if taken to another locality, where the disease does not exist, may not be attacked. Animals are subject to the disease at any time of life, but the largest percentage of cases occurs in horses under six years of age.

The disease appears very suddenly, sometimes over night. There is great irritation in the affected eyeball, sensitiveness to light and an excessive flow of tears, the eye being kept continuously closed, and drawn back into the eye socket. The conjunctiva or mucous membrane on the inside of the eyelid is very red, swollen, and may protrude between the closed lids. The blood-vessels around the eyeball are enlarged, and the eyeball is cloudy. After this has existed for a few days, healing usually begins. The sensitiveness to light diminishes, and the excessive secretion of tears lessens. However, some signs of the inflammation usually remain. In two weeks after the first attack, the eye may appear normal, but within varying periods of time another attack occurs, each attack producing greater and greater change, until finally sight is completely lost. Later, in about 25 per cent of the cases, the other eye becomes attacked in the same way. The outlook for recovery is poor.

Treatment.—Preventive treatment is most successful. The attendant should remove foals to a place where the disease is not prevalent. There is no good medicinal treatment for the disease. The old methods of bleeding from the eye, setoning and blistering, are of no value, and should not be used. Treatment consists in keeping the animal in the dark, and washing off the eye several times daily with a 4 per cent solution of boric acid. A few drops of this solution may also be dropped into the eye with good results. Ice poultices may be used over the eye for the first three or four days, after which warmth should be applied by covering the eye with cotton soaked in warm water, and kept in place by means of a flannel hood placed around the head. In recent years, the administration of potassium iodid, one to two drams daily, has been recommended.

Lampas or lampers.

This is a condition in which the mucous membrane in the roof of the mouth becomes congested with blood and protrudes below the incisor teeth. It is frequently observed temporarily at the time of eating. In some cases, however, it may become excessive, especially in colts during the eruption of the permanent teeth, when it may be relieved by making a few shallow punctures in the mucous membrane with a sharp knife that has been sterilized. Such treatment demands expert care. Searing the roof of the mouth with a hot iron is very cruel, and never of any value. It is only on the rarest occasions that any treatment is necessary. This ailment is not common.

Osteoporosis, or bighead.

Osteoporosis is a general disease of the bones, which develops slowly, and is characterized by the absorption of the compact bony substance, and the formation of enlarged, softened and porous bone. It is particularly manifest in the bones of the head, causing enlargement and bulging of the face and jaws, thereby giving rise to the terms, "bighead" and "swelled head," which are applied to it. In the United States the disease has been found in all the states bordering the Delaware river and Chesapeake bay, in some of the New England states, and in many of the southern states, especially along the coast in regions of low altitude. The idea that the disease is contagious has been advanced by many writers, although no causative agent has been isolated.

Probably the first symptom to be noticed is a loss of vitality combined with an irregular appetite or other digestive disturbance, and with a tendency to stumble while in action. These earlier symptoms, however, may pass unobserved, and the appearance of an intermittent or migratory lameness without any visible cause may be the first sign to attract attention. About this time, swelling of the bones of the face and jaw, which is almost constantly present in this disease, will be observed. (Fig. 450.) The bones of the lower jaw are the most frequently involved, and this condition is readily detected with the fingers by the bulging ridge of the bone outside and along the lower edge of the molar teeth. A thickening of the lower jaw-bone may likewise be identified by feeling on both sides of each branch at the same time and comparing it with the thinness of this bone in a normal horse. Other bones of the

Fig. 450. Bighead (*Osteoporosis*).

body will undergo similar changes, but these alterations are not so readily noticed except by the symptoms they occasion. The animal becomes poor in flesh, the coat is rough and lusterless, and the skin tight and harsh, producing a condition termed "hidebound," with considerable "tucking up" of the abdomen. The horse shows a short, stilted, choppy gait, which later becomes stiffer and more restricted, while on standing, a position simulating that in founder is assumed, with a noticeable drop to the croup. The animal at this stage usually lies down and remains recumbent for several days at a time. Bed-sores frequently arise and fractures are not uncommon, in consequence of attempts to arise, which complications, in addition to emaciation, result in death.

Treatment.— The affected animal should be immediately placed under new conditions, both as to feed and surroundings. If the horse has been stable fed, it is advisable to turn him out on grass for two or three months, preferably in a higher altitude. If the disease has been contracted while running on pasture, the animal should be placed in the stable or corral. In the early stages of the disease, beneficial results have followed the supplemental use of lime in the drinking-water. One peck of lime, slaked in a cask of water and additional water added from time to time, is satisfactory and can be provided at slight expense. This treatment may be supplemented by giving a tablespoonful of powdered bone meal in each feed, with free access to a large piece of rock salt; or the bone may be given with four tablespoonfuls of molasses mixed with the food. Feeds containing mineral salts, such as beans, cowpeas, oats and cottonseed meal, may prove beneficial in replenishing the bony substance that is being absorbed. Cottonseed meal is one of the best feeds for this purpose, but it should be fed carefully. The animal should not be allowed to work at all during the active stage of the disease, nor should it be used for breeding purposes.

Rheumatism.

Rheumatism is a painful febrile disease, affecting both the muscles and joints, and seen principally in the horse, ox and dog. The exact cause of the disease is unknown, although many theories have been advanced. As predisposing causes may be mentioned dampness and chilling. In the horse and ox it usually affects the muscles and joints of the extremities. It rarely becomes generalized (spread over the entire body) in any of the domestic animals.

The animal attacked suddenly becomes stiff and lame, followed by a rise of temperature (104° Fahr.). A swelling appears around one or more of the joints of the legs, which is exceedingly painful to the touch. The point of localization changes frequently, and one day the animal may show lameness in one joint, as for example, in the hock, and on the following day the hip or even the opposite leg may be affected. The attacks are also intermittent, and the animal may go sound for two or three days between them. The death rate is very low, as the disease rarely proves fatal when uncomplicated.

Treatment.—First of all, a cathartic should be administered. Aloes balls containing 7 drams of aloes for the horse and 1 to 1½ pounds of Epsom salts for the cow will give good results. At the same time, great benefit may be secured by thorough rubbing of the affected joints or muscles with some stimulating liniment, as camphor or chloroform liniment, which can be purchased ready-prepared at any drug-store. In this treatment, the rubbing does equally as much service as the liniment. The cathartic should be followed by some antirheumatic medicines, as the salicylates, given principally in the form of sodium salicylate. For the horse and the cow, 6 to 8 drams may be given two or three times daily in the food. In the sheep, dog and pig, ½ to 2 drams should be dissolved in water and given as a drench. During the treatment the animal should be kept in a dry place, and have plenty of fresh air.

Colic.

Colic is a collective term applied to all forms of pain in the digestive tract. The term "false" colic is frequently given to pain affecting the abdominal organs, as the liver, kidney and bladder. It is a very common disease, as in horses it forms about 10 per cent of all their ailments, and about 10 to 15 per cent of the affected animals die.

From the anatomical arrangement of the digestive tract, especially of the stomach, which does not allow of vomiting, the horse is more subject to colic than any other animal. Eating at irregular intervals, overloading of the stomach or prolonged absence of food, the presence of worms in large numbers in the alimentary canal and fermentation in the intestinal tract, due to the ingestion of new corn or hay, or sour decayed food, are causes. Sometimes the intestines become displaced or may become telescoped on themselves during unusual exertion; or a loop of the gut may pass down through the inguinal canal, causing the blood-supply to be shut off as a result of pressure, and giving rise to a rapidly fatal form of colic.

The symptoms are mainly those of pain. If the animal is in harness, he lags and stops; if urged forward, he will lie down in the shafts; if in the stable, he stops eating and walks around the box-stall restlessly. The animal looks around at the side, kicks at the belly, and may grit the teeth. The tail gets a peculiar crook in it and is held extended. The animal gathers its feet together as if to lie down, and when apparently it is going down it suddenly straightens up again; or it may lie down, roll, kick, and at times when the pain is severe may make very violent movements, as slamming the head against the ground or biting at itself or the manger. The attacks are sometimes intermittent and the animal will appear to be eased and may start eating, but this is only temporary. There may be fermentation in the intestines, with consequent gas formation, and great distention of the abdomen may occur. The patients are usually constipated and intestinal movements

lessened or entirely stopped. The rectum is frequently filled with dry, hard feces. The duration of colic is usually short, varying from a few minutes to several hours. If the pain is continuous for twenty-four hours the outlook for recovery is grave.

Treatment.—First of all, the animal should be given plenty of room in a large stall or shed, the floor of which should be covered with an abundance of straw in order to prevent the animal producing permanent injuries to itself during its violent movements. Sometimes, especially in chronic colic, walking exercise is to be recommended. One must use judgment in this respect, as there are many cases of colic in which the animals are much better if allowed to remain quiet. The internal treatment should be directed toward allaying the pain. For this purpose, cannabis indica, one to two ounces, may be given ; or morphine sulfate, five to seven grains, given subcutaneously. Larger doses of either should not be given, as cannabis indica stops intestinal movements and morphine in larger than seven-grain doses in the horse produces excitement instead of quiet. The following is an excellent prescription for many forms of colic :

Fluid extract cannabis indica	4 drams
Tincture opium	6 drams
Sulfuric ether	1 ounce
Sweet spirits of niter	1 ounce

Give in one dose and repeat if necessary in one hour. The intestines must be stimulated, for which purpose eight drams of aloes or one pint of linseed-oil may be given. Injections of lukewarm water into the rectum after cleaning out the fecal matter with the hand will sometimes stimulate the intestinal movements. In fermentation colic with gas formation, tapping the animal is the quickest and surest method of getting relief. A sterile trocar is necessary for this operation. The puncture is made on the right side midway between the angle of the haunch, the spinal column, and the border of the last rib. The skin should be washed with a 5 per cent carbolic acid solution or some other antiseptic and the trocar pushed through the skin into the intestine. The stilette should then be withdrawn, leaving the canula in place through which the gas escapes. When all the gas is evacuated, the stilette is again inserted and the instrument withdrawn. This can be repeated if gas continues to form, care being taken not to push the instrument in the same place twice.

Thumps.

This term has been applied to peculiar throbbing movements of the sides of the chest, caused by spasmodic contractions of the diaphragm. It is analogous to hiccoughs in man. The condition is easily recognized, the only thing with which it could be confused being palpitation of the heart. In thumps, however, the movements involve the whole side of the chest and are entirely independent of the heart-beats and less frequent. The breathing is rapid, jerky and incomplete. By placing the hand on the chest near the last rib, which is opposite the insertion of the diaphragm, the contractions may be felt as distinct throbs against the fingers. The condition may last for only a few minutes, or may continue for several days, lead to congestion of the lungs, and terminate fatally.

Treatment.—Frequently a single dose of some antispasmodic, as 4 drams of asafetida, or 5 ounces of the milk of asafetida, will relieve the condition. If this is not successful, nerve sedatives, as morphine sulfate, 5 grains, or potassium bromid, 1 ounce, should be administered. In obstinate cases, a purgative dose of 8 drams of aloes or 1 pound of Glauber's salts, should be given.

Heaves.

This is a disease of the lungs of horses, due to a loss of elasticity and permanent distention of the walls of the minute air-sacs in the lungs. Horses that stop and start a great deal, as milk-wagon horses, are predisposed to the affection. Clover hay and various other bulky foods containing little nutritive elements, and thus requiring the ingestion of large quantities to supply the needs of the animal, are also considered a cause.

One of the first symptoms of the disease is the distressing dry cough which frequently occurs in paroxysms. It can best be produced by giving the animal a drink of cold water, or by bringing it suddenly from a warm stable into the cold outdoor air. There is also present the characteristic double respiration, and the expired air comes from the nose in two jets, with a pause between them ; the flank movements are pronounced, and the anus is forced backward at each expiration. Inspiration is usually normal.

Treatment.—The condition is incurable, and all medicinal agents are only palliative. The greatest benefit is to be derived from the regulation of the diet. All dusty hay should be withheld, and only small quantities of the best timothy hay given, which should be well sprinkled with lime or molasses water. Nutritious concentrated foods should be given so that relatively small quantities will be required, as the less aliment in the digestive tract the more easily the animal can breathe. Corn, oats and bran, with carrots, turnips or apples mixed in, are good. Keep out on pasture when possible, away from the dust of the stable. Do not allow the animal to drink water just before a drive.

Medicinally, arsenic is good for a time, given in the form of arsenious acid, three grains, three times daily in the food. As arsenic is poisonous its general use is not advised. Fowler's Solution would be safer in this instance. Constipation should be avoided, and when any tendency in that direction is noticed, one and one-half pints of linseed oil, or a pound of Glauber's salts should be given as a drench.

Laryngitis or sore throat.

This is an inflammation of the lining membrane of the larynx (voice-box), caused by exposure, chilling, cold air, and also by the inhalation of irritant vapors as smoke or chlorine gas. It is classified according to the duration of the affection into

acute and chronic laryngitis. In the acute form, there is a rise of temperature with general symptoms of depression and a constant, more or less painful cough. The animal coughs on the slightest pressure in the region of the throat, when allowed to drink cold water, or when excited from any cause. If the ear is placed against the upper part of the neck, just back of the jaws, a gurgling sound may sometimes be heard. The sound is produced by the to and fro movement of fluid in the larynx at each inspiration and expiration. The head is held stiffly and extended on the neck, and a discharge appears from both nostrils, accompanied by fluid in the larynx.

Treatment.—The best results are obtained by means of local applications. Toward this end, absorbent cotton soaked in warm water should be placed around the throat and evaporation prevented by means of oiled silk or rubber cloth on the outside, which is kept in place by means of a bed-ticking bandage passed around the head and tied over the poll. Internally, a mixture containing potassium chlorate 1 dram, codiene hydrochlorate 2 grains, powdered licorice-root 5 drams, and sufficient honey or molasses to make a soft paste, should be spread over the tongue or teeth twice daily. Potassium iodid, ½ dram, two or three times daily, is also valuable. In severe cases showing no tendency to improvement, steaming is to be recommended. This is accomplished as follows: The bottom of a large bran sack is covered with a thick layer of bran. A bucket of water is heated to the boiling-point, three or four ounces of creolin added, and the whole poured quickly into the sack on the bran. The open end of the sack is then immediately tied around the horse's head, so that the animal will have to inhale the steam that rises inside the sack. (Fig. 451.) This may be done twice daily, and may be very beneficial in its effects.

Fig. 451. Steaming a horse for sore throat.

Bronchitis.

Bronchitis is an inflammation of the bronchial tubes. The causative agents are very similar to those causing laryngitis, as chilling, sudden inhalation of cold air, standing in draughts, or the inhalation of smoke and other irritating gases or vapors. It also frequently results from an extension of a preëxisting inflammation of the larynx in laryngitis.

The disease is ushered in with a rise of temperature, and the animal becomes droopy, the appetite is reduced and breathing is rapid. This rise of temperature varies with the severity of the attack, and may reach 106° Fahr. The cough is painful, barking, and comes from deep down in the respiratory tract. In the beginning stages it is dry, later becoming moist and accompanied by a nasal discharge. The duration of ordinary uncomplicated bronchitis usually extends over a period varying from one to three weeks and terminates in recovery.

Treatment.—The general surroundings should be good. Keep the animal in a cool place in summer and a sheltered place in winter. Tempt the appetite, which is likely to be fickle, with different kinds of food, as bran mash, oats and grass, until something is found that it will eat. Steaming the animal as described under laryngitis is to be highly recommended.

In order to prevent the spread of the inflammation into the air-sacs, and also to arrest the formation of fluid, a mustard plaster should be applied to the sides of the chest. Mix about one-fourth-pound of mustard in one pint of water and rub over the sides of the chest, being careful not to get it under the front legs where the skin is soft and the irritation it causes is very great. A mustard plaster of this strength need not be washed off and may be repeated in two or three days. Mustard plasters must be used with caution, as they are very likely to leave a blemish.

Internally, a paste consisting of ammonium chlorid 1 dram, morphine sulfate 3 grains, powdered licorice root 6 drams, and sufficient molasses to make a soft mass, should be spread over the tongue twice daily. General stimulants, such as alcohol 2 ounces, tincture of digitalis 1 dram, may be given in cases of heart weakness. During the course of the disease a bucket of cold water should be kept constantly before the animal. If the disease tends to become chronic, potassium iodid in one-half-dram doses, or arsenious acid in three-grain doses, should be given twice daily over a period of two weeks.

Pneumonia.

Pneumonia is a common disease of the horse, usually involving a lobe or even an entire lung. The lung becomes solid and of the consistency of liver, due to the filling of the air-sacs with exudate. Ill health, excessive excretion and chilling are predisposing causes, while the direct cause is a micro-organism.

The onset is sudden, with chill and very high fever, 105° or 106° Fahr., depression, muscular weakness, short dry cough, and increased pulse and respiratory rate. Physical signs are present on examination of the chest. The temperature remains high for seven to fourteen days, and in favorable cases drops suddenly, accompanied by a resolution of the inflammation in the lungs, a moist cough, and a discharge resembling prune-juice from the nose. The disease may terminate completely in ten to twenty days, or may pass into a chronic state and last for two or three months, or lead to permanent broken wind. The death rate is low, except in old worn-out horses, and those weakened by previous disease.

Treatment.—Place the animal in comfortable, roomy surroundings, and tempt him to continue eating by offering various kinds of food in small

quantities. Milk will often be drunk when all else is refused. Apply a mustard plaster to the chest, as in bronchitis.

Medicinally, stimulants are indicated, as a mixture consisting of tincture of digitalis 1 dram, tincture of nux vomica 1 dram, quinine sulfate 1 dram, water in sufficient quantity to make an ounce, and given three or four times daily for several days or a week. When convalescence is established, arsenic in three-grain doses and iron in one-dram doses may be given in the feed. When the symptoms have disappeared, potassium iodid in one-half-dram doses twice daily should be given for a week, to aid in the complete absorption of the inflammatory exudate.

Abscesses (*poll evil, fistula, etc.*).

Abscesses are well-defined collections of pus. They are characterized by the fact that they increase in size slowly, show symptoms of acute inflammation, are firm to the touch, although later they may show fluctuation. They follow as the result of local inflammation in glands, muscular tissue, or even bones. They are very common in the first two cases. The abscesses most commonly met with in horses are those of the poll (*poll evil*), the withers (*fistula*) and the glands which occur during the existence of *strangles* or *colt distemper*. At first the swelling is uniformly hard and resisting over its entire surface, but in a little while becomes soft—fluctuating—at some part, mostly in the center. From this time, the abscess is said to be "pointing" or "coming to a head," which is shown by a small elevated or projecting prominence, which at first is dry, but soon becomes moist with transuded serum. The hairs over this part loosen and fall off, and in a short time the abscess opens, the contents escape, and the cavity gradually fills up, and heals by granulations.

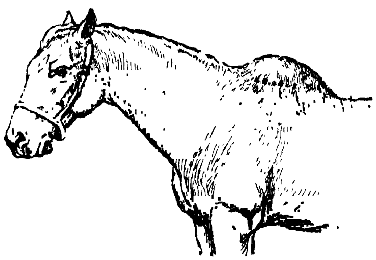


Fig. 452. Fistulous withers.

Treatment.—Abscesses in muscular tissue, such as poll evil and fistula of the withers (Fig. 452), are usually the result of bruises or injuries. In all cases when abscesses are forming, we should hurry the ripening process by frequent hot fomentations and poultices of bread, bran, or flaxseed. When they are very tardy in their development, a blister composed of one part of cantharides and ten parts of vaseline, rubbed over their surface, is advisable. It is a common rule with surgeons to open an abscess as soon as pus can be plainly felt, but this practice can not be recommended to owners of stock indiscriminately, since this operation requires an exact knowledge of anatomy. This is imperative if the abscess is in the region of joints. When open, we must not squeeze the walls of the abscess to any extent. They may be very gently pressed with the fingers at first to remove the clots (inspissated pus), but after this the orifice is simply to be kept open by the introduction of a clean probe, should it be disposed to heal too soon. If the opening is at too high a level, another should be made into the lowest part of the abscess so as to permit the most complete drainage. Hot fomentations or poultices are sometimes required for a day or two after an abscess has opened, and are particularly indicated when the base of the abscess is hard and indurated. The cavity should be thoroughly washed with stimulating antiseptic solutions, such as 3 per cent solution of carbolic acid, 3 to 5 per cent solution of creolin, 1 to 1,000 bichlorid of mercury, or 1 per cent permanganate of potash solution. If the abscesses are foul and bad smelling, their cavities should be syringed with one part of hydrogen peroxid to two parts of water, followed by the injection of any of the above-mentioned antiseptics.

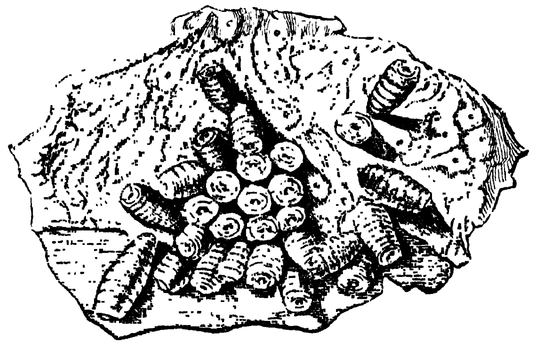


Fig. 453. The appearance of bots in stomach of horse. (From Diseases of the Horse, U. S. Dept Agric.)

Bots. (Fig. 453.)

Bots are the larvæ of the bot-fly, a heavy-bodied hairy insect. The larvæ are thick, fleshy grubs living practically in the intestinal tract of horses. The injury to the horse from the presence of the larvæ may take one or all of four forms : (1). The attachment to the walls of the stomach may cause an irritation which may interfere with the normal action of the glands that secrete digestive juices ; (2) the bots abstract some nutriment from the walls of the stomach, or by absorption from the food content of the organ ; (3) by collecting, particularly in the region of the pylorus (opening of the stomach into the intestine), they serve as an obstruction to the free passage of food from the stomach into the intestine ; (4) in passing through the intestine after they have released their hold on the walls of the stomach, they may attach themselves to the intestinal wall or rectal walls and cause great irritation.

The eggs are deposited in the hair, usually of the front legs and chest of a horse, and are held there by a sticky fluid, which quickly dries and glues them firmly in place. The eggs are taken into the horse's mouth by licking, and if so taken between the tenth and thirteenth day after the deposition, will develop into the bot in the animal's stomach.

Treatment.—By far the most important point is

to prevent the introduction of the larvæ. The eggs are very plainly seen on the hair, and it is evident that if they are removed before the tenth day (at which time they begin to hatch) the animal cannot get bots. Eggs may be removed in several ways: by washing the hair in a dilute carbolic acid solution, one part acid to thirty parts of water, by rubbing the parts lightly with kerosene, or by clipping. Horses pastured in July, August and September should be examined every three or four days, and if the eggs are present they should be removed.

It is, of course, not an easy matter to determine whether any particular disturbance of the digestive organs is produced by bots or by some other agency producing similar symptoms. If occasional bots are noticed in the manure of the animal, together with poor condition, their presence in numbers is to be suspected. The animal should then be starved for twelve hours, allowing only water, after which give two teaspoonfuls of tartar emetic in water as a drench. Repeat in four hours' time. Eight or twelve hours afterward give a drench of one pint to one quart of linseed oil.

Worms (Ascarides, round worms).

These worms are found in all domestic animals. The round worm of the horse (*Ascarid megalocephala*) is about five to six inches in length by one-fourth inch in thickness, and white in color. It is easily detected in the feces, its presence in which is the only sure sign.

Treatment.—For the horse, tartar emetic is recommended in two-dram doses every four hours until three doses are given, care being taken to starve the animal twelve to eighteen hours before administering, and to follow it in three or four hours with one and one-fourth pints of linseed-oil.

Fig. 454.
Capped hock.

Capped elbow or hock.

These conditions are somewhat similar in their nature, although capped elbow is the more common and more serious condition. It is caused by repeated mild injuries from lying on an unbedded floor or by lying with the shod hoof bent under the body so that the shoe comes in contact with the elbow. Capped hock results from striking the point by kicking backwards against the side of the stall or other hard object. (Fig. 454.) The severity of the condition may vary from a slight inflammation with edema to cyst development, or abscess formation, and even organization of the inflammatory exudate with the presence of a large fibrous tumor on the elbow, commonly called a shoe boil. In some cases these shoe boils may reach the size of a child's head, and may be very firm and hard or soft and flabby.

Treatment.—In the early stages, the main object is to prevent recurrence of the irritation. To accomplish this in capped hock, the animal should be placed in a large stall with the sides and posts well padded. In capped elbow the branches of the shoes should be shortened and their ends bevelled forward, and a heel boot should be worn while in the stable. The stall should also be well bedded, and a dirt floor is better than boards or cement. When a cyst containing a serous fluid is present, it should be aspirated with a sterile syringe or drained off with a sterile trocar. If pus is in the sac, it must be opened with a free incision in the most dependent part and washed out with hydrogen peroxid diluted half with water, or 3 to 5 per cent creolin solution. Stimulating liniments and even blisters, in the subacute cases without pus formation, may cause a resolution and absorption of the inflammatory products. In the old standing cases with the presence of a fibrous tumor, the only treatment is the surgical removal of the mass. The condition may last for years, however, without reducing the working capacity of the animal.

Curb.

Curb is an unsoundness in the horse sometimes leading to lameness. It is caused by a rupture of the ligament on the posterior surface of the hock. (Fig. 455.) The inciting causes consist in a defective conformation of the leg, and in sudden strains during heavy draft work or under the saddle. In recent cases there is some swelling and heat about the posterior surface of the hock, with lameness. On examining the hock joint in profile, the leg, which normally should be perfectly straight, shows a bulging backward below the point of the hock. A well-marked curb may be present and cause slight or no lameness.

Fig. 455.
Leg showing curb.

Treatment.—This aims to remove the lameness but cannot remedy the blemish. In the early stages, when there is heat and edema about the part, showing the presence of an acute inflammation, cold water should be applied for ten or twelve hours daily from a rubber hose, which is connected with a faucet passed over the back of the animal and tied to the leg by tapes. If lameness persists after about a week, a blister of biniodid of mercury one part to vaseline eight parts should be applied and the animal allowed to rest in the stable for two to four weeks. In the great majority of cases, this will effect a cure. A certain percentage of cases, however, are obstinate and require point- or line-firing, which must be administered by a veterinarian.

Cartilaginous quittor.

This is a chronic suppurative inflammation of the lateral cartilage leading to necrosis and the

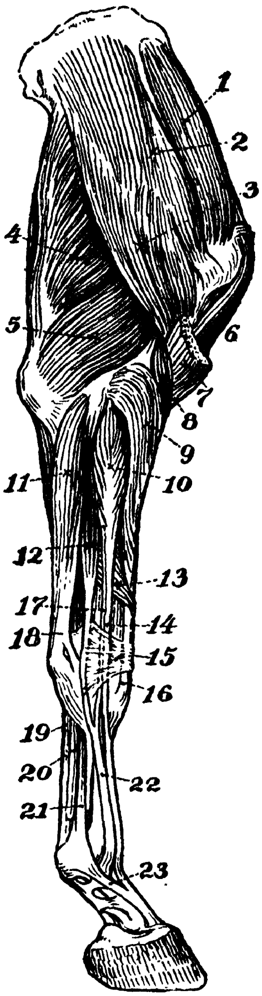


Fig. 456.
Muscles in the normal leg of a horse. 1, M. supra-spinatus; 2, M. Infra-spinatus; 3, M. deltoideus; 4, long head of M. triceps; 5, lateral head of M. triceps; 6, M. biceps; 7, M. sterno-cleido mastoideus; 8, M. brachialis internus; 9, M. extensor carpi radialis; 10, M. extensor digitorum communis; 11, M. extensor carpi ulnaris; 12, M. extensor digiti minimi; 13, M. abductor pollicis longus; 14, principal tendon of the M. extensor digitorum communis; 15, fibrous sheath; 16, tendon of M. extensor carpi radialis; 17, small lateral tendon of M. extensor digitorum communis; 18, tendon of M. extensor carpi ulnaris; 19, M. flexor digitorum sublimis; 20, flexor digitorum profundus; 21, interosseus medius; 22, extensor digiti minimi; 23, lateral part of interosseus medius. (After Ellenberger.)

formation of discharging sinuses. It is most often seen in the front feet of heavy draft horses, and especially in animals that have flat hoofs with low quarters and heels. The exciting causes of quittor are corns, deep quarter cracks, or tread wounds and other inflammatory conditions which allow the entrance of microörganisms.

There is first noticed a swelling and inflammation in the region of the quarters, extending upwards above the hoof. This increases until finally pus is formed and breaks outward through the skin. In old cases, several openings may be present, together with scars of old sinuses that have healed. The horny hoof is bulged outward and there may be lameness, although this is not a marked symptom, and the animal is frequently able to continue at slow work. The course of the disease is chronic and frequently covers several months. There is danger of serious complications arising.

Treatment.—In the treatment of this condition, a great variety of remedies have been tried. Soaking the foot in a tub containing 1 per cent creolin solution is valuable. When the animal is working daily, injections of antiseptic solutions and protecting the part with bandages should be tried. This, in addition to the careful injection once each week of a small quantity of a saturated aqueous solution of bichlorid of mercury, through a syringe with a narrow nozzle that reaches to the bottom of the sinus, is very good treatment. In severe cases the condition can be permanently cured in a comparatively short time by the operative removal of the entire lateral cartilage.

Scratches.

This is an inflammation of the skin in the hollow of the fetlock, of various degrees of intensity. Among the common causes may be mentioned standing in manure and urine, too frequent washing of the skin with irritating soaps, working in stubble fields, alkali dust, salt from the car tracks in winter during snowy and icy weather, and bacteria. It is most common on white-footed animals. There may be a mere reddening of the skin, or the skin may contain transverse fissures that gap on extension of the part in walking. In more severe cases, warty excrescences may form around the borders of the fissures and project above the surface, and rarely the condition may go on to gangrene. The skin is thickened, thrown into transverse folds and tender to pressure.

Treatment.—The first essential in the treatment of the condition is to remove the cause. The animal should stand in a clean, dry stall, and all long hair should be cut away from the hollow of the fetlock. The parts should then be washed clean with castile soap and warm water and thoroughly dried. Frequent washings delay the healing process. If any warty outgrowths are present, they should be snipped off with the scissors or removed with the hot iron. In the milder cases, astringent powders may be applied, as tannic acid or equal parts of zinc oxid and boric acid. In the more severe cases, ointments are more valuable, as 10 per cent ichthyol ointment or wet astringent dressings, as Burrough's lotion. The latter is composed of alum 30 grams, lead acetate 24 grams, spirits of camphor 60 cc. and water in sufficient quantity to make 500 cc. The parts should be dressed twice daily in severe cases.

Founder.

Founder is an inflammation of the soft structure, especially the fleshy leaves, enclosed within the horny hoof, accompanied with constitutional disturbances, and frequently leading to marked anatomical changes in the structures of the foot. The causes of this disease are imperfectly understood. Concussion, excessive ingestion of certain grains, long drives, standing in unprotected places, or drinking cold water while the body is overheated, are all considered causes. Long standing on one foot when the opposite one is diseased, frequently leads to the development of founder. The condition is more common in the front feet, although all four may be affected.

The disease is of sudden onset, with fever from 102.5° to 106° Fahr., rapid respiration, increased pulse rate, and intense pain in the affected feet. Indeed, the pain is so great that the animal cannot be moved out of the stall or made to walk, nor can one foot be raised from the ground if the opposite one is affected ; and great difficulty is experienced in getting the shoes removed. The animal stands with the hind-feet well under the body to relieve weight from the affected fore-feet. Marked throb-

bing of the artery along the inside of the cannon-bone is present. On tapping the wall of the hoof with a hammer, extreme pain is produced, as shown by flinching and tremor of the muscles.

Treatment.—When the condition is recognized within the first twenty-four hours of the attack,

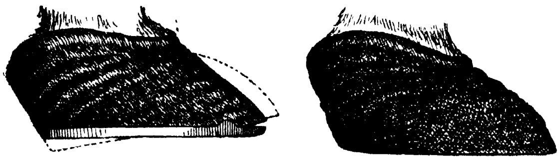


Fig. 457. Shod and unshod hoofs in founder. (Figs. 454, 455, 457, 459, after Moller-Dollar.)

bleeding is highly recommended, and six quarts of blood should be drawn from the large vein in the neck. The object of this measure is to lower blood pressure. The internal administration of tincture of aconite in ten-drop doses every two hours during the first day, will have the same effect. Locally, cold should be applied to the affected feet, by allowing the animal to stand in a soaking-tub, or, preferably, in a puddle of soft clay, the water of which is kept cold by the addition of ice. Internally, two-ounce doses of saltpeter in a pint of water should be given three times daily, for a period of a week. In those cases which fail to respond to treatment, and the anatomical changes occur in the structure of the foot, the hoof will be deformed (Fig. 457), and we can only hope to make the animal useful for slow work, by properly dressing and shoeing the hoof.

Penetrating nail.

This condition is a not uncommon accident, especially in city horses. The nail usually penetrates the point or lateral cleft of the frog and may pass deeply into the soft structures. The accident should always be considered serious, as it may lead to lockjaw or suppuration and necrosis of the soft structure within the horny hoof.

Treatment.—The nail should be removed if it is found in the wound. The horny sole or frog should be carefully cut down to the soft tissue for a distance of one-fourth to one-half inch on all sides of the puncture. The hole formed by the nail should then be treated with some antiseptic solution, as 5 per cent creolin or carbolic acid solution or tincture of iodine. In the absence of these, turpentine may be used. The animal should then be made to stand in a soaking-tub, containing 1 per cent creolin solution, for several days. If this is not possible, a wet antiseptic poultice should be tied over the hoof. This can be made of bran, saturated with a 3 per cent creolin solution and kept moist by adding more of the solution from time to time. This should be kept in place and changed daily until all lameness and discharge from the wound ceases.

Bone spavin.

This term is applied to any bony enlargement around the hock, the usual seat being on the inner and inferior surface of the joint. It is the result chiefly of defective conformation, heredity, hard work, slipping and sprains of the hock joint.

Spavin is a very prevalent condition and is the most common cause of lameness in the hind-leg. It is usually gradual in its onset. The lameness is somewhat characteristic, in that it is most marked when the animal is first brought out of the stable and disappears on warming up. The animal brings the toe down first, and this part of the shoe shows greatest wear while the heels of the hoof tend to become high and stubby. The lameness is intensified by the spavin test, which consists in holding the hock joint strongly flexed for three minutes and then starting the animal off suddenly. The positive proof of spavin consists in the presence of a bony enlargement, usually on the inside, low down on the hock joint. While spavin may be suspected, it is doubtful whether a diagnosis should be made before the bony enlargement can be recognized. (Fig. 458.) In occult spavin, where the inflammation is within the joint, this enlargement does not appear until late.

Fig. 458. Leg showing spavin.

Treatment.—This cannot remove the bony growth entirely but may be successful in removing the lameness. In shoeing the animal the heels should be spared, the toe shortened and the shoe should have heel-calks. Four to six weeks' rest with repeated blisters may give temporary relief. The most successful treatment, however, requires the assistance of a veterinarian, and consists in the combination of cutting the cunean tendon in conjunction with penetrant point-firing. This hastens the welding or ankilosis of the articular surfaces of the inflamed bones, the movement of which is the direct cause of the pain and lameness.

Ringbone.

This term is applied to any new bony growth on the phalangeal bones. It is most common in the front leg and on the lower end of the long pastern or upper end of the short pastern. The causes are both internal and external. The internal causes are predisposing and consist in abnormal directions of the phalanges, improper dressing of the hoof and heredity. The exciting causes are hard work early in life, fast driving on hard roads, missteps, strains and deep tread wounds.

The onset is gradual. Lameness develops gradually or may come on suddenly after stumbling or a strain. It is made worse by fast work on hard roads. At rest the animal "points." There is local heat, swelling and pain on passive rotation of the foot in some cases. The most important symptom is the presence of a bony enlargement about the joint (Fig. 459), and when this is absent, as it may

be in early articular ringbone, the diagnosis is difficult. A large ringbone may be present, on the other hand, without causing lameness.

Treatment.—The foot should be properly dressed and shod. If lameness is marked, prolonged rest and repeated mercurial blisters (one part of biniodid of mercury to eight of vaseline) should be applied. If this is unsuccessful, deep penetrant point-firing should be done by an expert veterinarian to produce a welding of the articular surfaces and thus prevent movement which causes the pain. As a last resort in this disease, double plantar neurectomy has to be performed, for the animal to be able to work.

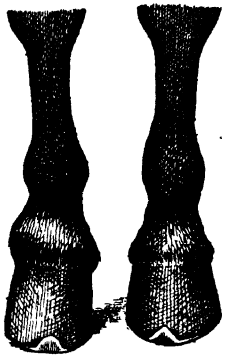


Fig. 459. Leg showing ringbone at left; at right, normal leg.

Splint.

This is a very common condition in the horse, produced by the deposit of new bone between the cannon and rudimentary metatarsal or splint bones. Its most common seat is on the inside of the front leg, due to the anatomical arrangement of this region, which subjects the internal splint bone to more pressure than the external one. External injuries may rarely be a cause. The condition generally occurs before the fourth year of age, at which time the splint bones become welded to the cannon bone by ossification. The new bony growth may sometimes be seen, and can always be readily felt by running the fingers along the front of the internal splint bone at its junction with the cannon. The normal button-shaped termination of the splint bone in the lower one-third of the cannon should not be mistaken for a splint.

In a small percentage of cases splints lead to temporary or obstinate lameness. The lameness becomes apparent after speeding on a hard road, and the animal will rest out of the lameness. Pressure over the splint will cause the animal to flinch. The skin will show an increase of temperature at this point and there may be some edema.

Treatment.—Only those cases causing lameness should be treated, as the blemish caused by the new bone formation cannot be benefited. In the early stages, when the inflammation is acute, cold water should be allowed to run over the part for several hours each day for a week. The hair should then be clipped short and a blister, consisting of biniodid of mercury one dram to one ounce of petrolatum, applied and rubbed well into the part. The animal should have three or four weeks' rest in the stable. In more severe cases, point-firing over the bony growth will be required to effect a cure. A veterinarian should be employed for the latter. Many cases will get well in time without treatment.

Literature.

In addition to the references mentioned on pages 124–146 and 330, regarding the diseases and ailments of live-stock, reference is here made to the following works: Law, The Farmer's Veterinary Adviser (1892); Special Report on Diseases of the Horse, revised edition, United States Department Agriculture, Bureau of Animal Industry (1903); Moller and Dollar, The Practice of Veterinary Surgery (1903); Fleming, A Textbook of Operative Veterinary Surgery (1884); Williams, the Principles of the Practice of Veterinary Medicine, revised edition (1890); Williams, The Principles of the Practice of Veterinary Surgery, revised edition (1890); Hopkins, Veterinary Elements (1901).

Arab Horse. Fig. 460.

By *Homer Davenport.*

The Arab horse is notable as a saddler, and to impart vigor, quality and intelligence in cross-breeding. His blood has been prominent in the development of the Percheron, Hackney, Thoroughbred, Russian Orloff, Triccaney, Hanoverian, French and German cavalry horses, the coach horse, polo ponies; in fact, a large proportion of our present-day types are more or less traceable to the influence of the Arabian horse.

Description.

The Arabian in his purity is a horse of high courage, possessing length, power and substance, combined with elastic and graceful movement. He is gentle and affectionate. He seems to have no fear of anything, even man, a trait shown particularly in young colts. In his native country he stands closer to fourteen hands and two inches than any other height; but his size is merely a matter of the feed given him when he is a colt, as is shown by the fact that among the Gomussa tribe of the Sabba Anazeh, who pay better attention to their horses than do others, we find colts at two years old standing fifteen hands high; and at the Circassian villages up the Euphrates, where even better care of the live-stock is taken than by any of the Bedouins, we find the Arab horse much advanced in size.

There is a peculiar balance and harmony throughout the frame of the Arab. The beauty of head, ears, eyes, jaws, mouth and nostrils is noteworthy. The ears are not small, but are so shaped that they appear small; the head is short from the eye to the muzzle, broad and well-developed above; the eye is soft and intelligent; the nostrils are long and appear puckered, drawn back up the face, and are capable of great distention; the neck is a model of strength and grandeur, of which he can make a perfect arch, that matches the arch of his tail. The throat is large and well developed; it is loose and pliant when at rest, and much detached from the rest of the neck. This feature is not often noticed, but it is indicative not only of good wind, but of the capacity for prolonged exertion without distress, owing to the great width between the jaws. The shoulder is good, as is the deep chest, the appearance of which is diminished by the big, deep ribs; the back is short, the loins of immense power, and the quarters long and strong, the whole

beautifully turned. The legs and feet are superior. The two great features, possibly, that a stranger would notice first in the Arab horse, are the forehead, or jibbah, which cannot be too prominent, giving a peculiar dish to the lower part of the face, and the tail, set high and carried in an arch. The form of the Arabian horse is essentially one of utility; the space for the seat for the rider is sufficient, and at once fixes his true position; the weight is therefore carried on that part most adapted for it. The rest of the frame is taken up with the powers of progression. The color varies, and may be white, gray, bay, chestnut, brown and rarely black. Roan, spotted or piebald and yellow colors are not found among the Arabs, although roan and yellow are common among Barbs. The bays often have black points, and generally one or more white feet, with some white in the face. The chestnuts vary from the brightest to the dullest shades.

History.

There has been a great deal of query as to where the Arab horse came from. It seems probable that he came originally from Mesopotamia, although some writers hold that his native home was in the vicinity of Nejd. According to Plumb, the Arabs are descendants of Ishmael, who, according to tradition, inherited a valuable horse of the Kuhl race. The Anazeh tribe descended in a direct line from Ishmael, through Sheik Salaman, who lived about 1635 B. C. (four generations removed from Ishmael), and who owned five famous mares. From this ancestry has come the purest and best Arab horse blood. This race was in existence many centuries before the time of Mohammed. Early in the seventeenth century Arab horses were brought to England, and in the eighteenth century the importations were numerous. These exerted considerable influence on the development of the Thoroughbred and the Hackney.

In America.—The first record we have of the Arab in America was the importation of the stallion Ranger, about 1765, to New London, Conn. In 1838, J. D. Elliott imported a number of both sexes. The late A. Keene Richards brought them to Georgetown, Kentucky, in 1856. His plant was making the most rapid strides toward success, when it was destroyed by the Civil war. The blood of his horses, however, is found in the present Kentucky saddle horses, six and seven generations back; and there is little doubt that much of the beauty of that splendid animal today is traceable to the horses that A. Keene Richards imported. The next importation was the two stallions given to General U. S. Grant, by the Sultan of Turkey. These were of unknown families, but they sired many beautiful and useful horses.

A number of Arabian horses were brought to the World's Columbian Exposition at Chicago, in 1893. The Sultan was induced to permit these horses to come to America for the exhibit, and through mortgages they were eventually held. Nine were burned to death in their stalls at the Exposition by the Syrians that brought them, as the outcome of a wrangle. From these horses, however, came the best results from any Arab horses brought to America. Most of them were bought by Mr. Peter B. Bradley, of Hingham, Mass., who crossed them on some of our best breeds, besides breeding them in their purity. With a pure horse of his breeding, Mr. Hess, of New York City, won the only blue ribbon ever won over our own types of saddle horses, with an Arab in open competition. Mr. Bradley also bred a trotter, two removes from Arab blood, that trotted to a record of 2:30 in the sixth heat of his first race. He produced the finest types of polo ponies and accomplished much with the Arab blood.

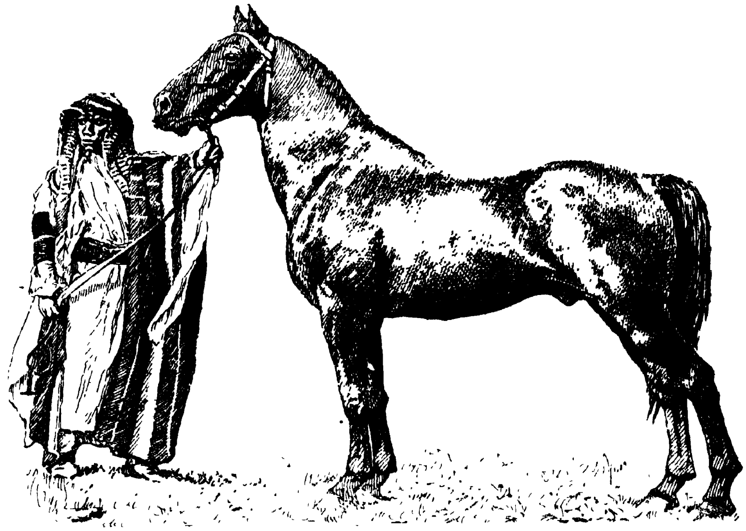


Fig. 460. Haleb. A champion Arabian stallion.

Distribution.

The home of the Arab horse, speaking of the pure Arab, is the district that is covered by the Nomad Arabs, and is confined to Arabia proper and the Syrian desert. In its greatest perfection it is found among the Anazeh and Shamar Bedouins, occupying the territory east and west along the Euphrates river; the Shamar on the eastern shore and the Anazeh west of the river. The latter make a circuit of the desert annually, going from the summer pastures near Aleppo, in the north, to Nejd, in the south, in winter. They swing east past Bagdad and Deyr on their way north, and on their journey south, go west, brushing near Palmyra and Damascus. Within that circuit the home of the Arabian horse may be said to lie. The haunts of the pure Arabian are those of the desert Bedouins, who still carry the lance. Of course, specimens of pure blood can be found sometimes at Beyrout, and the coast towns, but such horses have been brought

there by wealthy citizens. In like manner they have been carried into northern Africa, Persia, Turkey, Hungary, Germany, France, Russia, England and America.

The adaptability of the Arab is noteworthy. Accustomed naturally to the most intense heat, yet he thrives in the extreme cold, and the writer has known one to winter perfectly in the mountains of Pennsylvania. His coat, while fine and silky in spring and summer, in winter is as thick as a beaver's, and has an undercoating of fur-like hair.

Types and families.

It has been asserted that there were two breeds of Arabian horses, a large breed and a small breed. This is untrue; there is but one general breed of Arabian horses, of which there are many families, which are different and distinct in many ways. While there are not two distinct breeds, there are a first and a second class. A horse, or mare, about whose breeding there is the slightest doubt, is disqualified, and not called "chubby," and therefore is of the second class. The families originated and descended from some great mare. In all cases the breed of the colt is that of the dam, and not of the sire; thus, a colt, whose father had been a Hamdani Simri, and whose dam had been a Seglawieh Jedranieh, would necessarily be a Seglawi Jedran. The Bedouins count the father little, so long as he is "chubby," meaning a Thoroughbred that the Anazeh would breed from, but they place everything in the value of the mother's blood, and of her own individuality.

The Gomussa, of the Sabba Anazeh, are the shrewdest horse-breeders of the desert. They have retained, in the largest numbers, specimens of the five great families, which are called the Khamseh, which means five. They also have the choicest of the other families, which are rated equal in point of blood. The Khamseh, so the story runs, have descended from the five great mares, which, with other mares of Sheik Salaman, were drinking at the river after long hardships in war, when the trumpet blew, calling them back to battle. Only five responded to the call, and it was those five that founded the five great families.

(1) *The Keheilan Ajus.*—This strain is the most numerous, and from it all other Keheilans are offshoots. The words Keheilan Ajus mean the mare of the old woman, derived from a legend that the mare was dropped by its dam near a well kept by an old woman, where the rider had stopped. The traveler rode off in a short time, leaving the filly colt with the old woman. The next morning the colt was found by its mother's side, having traced her across the desert during the night. Among the Keheilans, bays are more numerous than any other color. They are the fastest, although not the hardiest horses nor the most beautiful. They bear a closer resemblance to the English Thoroughbred than any others, as they are more nearly related. The Darley Arabian, perhaps the only thoroughbred Anazeh horse in our studbooks, was a Keheilan of the sub-family called Ras-el-Fadawi.

(2) *The Seglawi family* have descended from four great mares owned by a man of that name. At his death he gave his favorite mare to his brother Jedran, and thus the Seglawi Jedrans are the favorites of the Seglawies; he gave the second mare to his brother Obeyran; the third to Arjebi; and the fourth to El-Abd, meaning the slave. Many writers consider that all four mares were full sisters. The Seglawi Arjebi are extinct, and of the remaining strains, the Seglawi Jedran ranks first in the esteem of the Bedouins, and Seglawi El-Abd second. Some years ago, Abbas Pasha, of Egypt, purchased nearly all of the Seglawi Jedran mares from the Anazeh tribe, paying as high a price, it is said, as 3,000 pounds, for a single old mare. Many chestnut-colored horses are found among the Seglawis; possibly, with the bays, they would form about an equal division.

(3) *Hamdani.*—The Hamdanis are not common anywhere on the Syrian desert, the Shammar being supposed to have the best. They are mostly greys, although very handsome browns and chestnuts are to be found in the Shammar. The only strain of the Hamdani that is counted "chubby" is the Hamdani Simri. Mares of the Hamdani Simri are very rare.

(4) *Abeyan.*—The Abeyan is generally the handsomest breed, but it is small and has less resemblance to the English Thoroughbred than any of the other families of the Arabian horse. The Abeyan Sherrack is the most esteemed of the seven strains of the Abeyan (and there are but two others of that seven, the Abeyan Zahaine and Abeyan Fadaha, that are counted "chubby"). It is the name of the family, and the other strains are derived from Abeyan Sherrack. Abeyan Sherracks carry their tail much higher than other Arabian horses. They are also noted for their prominent forehead or jibbah. Their endurance is remarkable. The colors are bay, chestnut and grey.

(5) *Hadban.*—There are five strains of the Hadban family, Hadban Enzekhi being the favorite, and Hadban al-Fert being the only other that is considered "chubby" by the Anazeh. The Gomussa of the Sabba Anazeh are supposed to have the best Hadbans at the present time. Brown and dark bay are the favorite colors of the Hadban Enzekhi family.

Other families.—Besides these five families, there are sixteen other families that are esteemed almost as much as the Khamseh: (1) The Maneghi, supposed to be an offshoot of the Keheilan Ajus. They are plain and without distinction, being somewhat coarse, with long necks, powerful shoulders, much length, and strong but coarse hind-quarters. They are strong boned, and are held in high repute as war horses. There are four sub-families in this group, the favorite being Maneghi Sbeyel, which is counted "chubby" all over the desert. Maneghi Hedruj, the next esteemed, is not counted "chubby" at Nejd, but is by some tribes of the northern desert. The family of Sbeyel of the Gomussa possesses the finest specimens of the strain known by that name. (2) Saadan, often very beautiful horses; the sub-strain, Saadan Togan, is the most highly esteemed. (3) Dakhman. (4) Shueyman.

The sub-strain of Shueyman Sbah are rated as first-class. (5) Jilfan. Of this there is a sub-strain, Jilfan Stam el Bulad, meaning the sinews of steel. In some parts of the desert, the Jilfan Stam el Bulad is prized equally with Hamdani Simri. (6) Toessan. Of this, there is the sub-strain Toessan Algami. (7) Samhan, with a sub-strain, Samhan el Gomeaa. The horses of this family are frequently very tall, and are much esteemed. (8) Wadnan, with the sub-strain, Wadna Hursan. (9) Rishan, with the sub-strain Rishan Sherabi. (10) Tamri. The Keheilan Tamris are highly prized. (11) Melekhan. (12) Jereyban. (13) Jeytani. (14) Ferejan. (15) Treyfi. (16) Rabdan. Besides these, there are the Keheilan Heife, Keheilan Kroash, Keheilan el-Ghazala, Keheilan al-Denais, Keheilan al-Nowak, Keheilan al-Muson, Keheilan abu junub, Keheilan Rodan, Keheilan Wadnam Harsan, Dahman abu Amr, Dahman Shawan, Dahman Khomais, Abu Arkab, all of which are considered "chubby." All these are Keheilans, and most, or all of them, have descended from Keheilan Ajus.

Feeding and care.

Unaccustomed to much feed, or regular feed, the Arab is likely to get very fat under our method of feeding, so that the horse, once the picture of all that is beautiful and graceful, with us may soon become a fat horse. He thrives best on half of what other horses require. Of all horses, the Arabian is least fit to stand idle in his stall. His life for centuries has been under the saddle, as a war horse, on the scantest rations any horse lives on; and to pen him up in a close stall and feed him three meals a day so completely changes his life, that it changes his form.

Uses.

For riding and driving.— As a saddle horse the Arab horse ranks high. He has always been accustomed to the saddle, and has developed remarkable endurance, carrying riders long journeys, day after day, in a scorching sun, with little feed or water. He can carry very heavy weights on his back. When hitched to the carriage, he makes a gentle, attractive, driving horse.

For crossing.— The importance of the Arab for cross-breeding purposes is well known. He has entered into the development of many of our present-day breeds,—trotting, running, saddle, coach and draft,—and has imparted his endurance, quality and intelligence wherever used. That he is still valued for this purpose is evidenced by the fact that in certain European countries Arab studs are officially maintained for breeding purposes. A new infusion of his blood is much needed in our modern horses. The farther we get from the Arab blood, that in former days was strong in our runners and trotters, the less our horses show of the powers of endurance that made them great animals. And while our race horses have become greater sprinters, they have lost much of their staying power. A fresh infusion of the best blood of the desert should improve those families of horses that have been bred in the extreme for any special purpose, to the exclusion of many of the qualities possessed in such a marked degree by the Arabian horse. One of the most noticeable differences between our best types of today, especially in America, and the Arab horse, is the flat and contracted sides of our horses compared with the round, barrel-shaped ribs of the Arabian and the narrow openings of the jaw-bones of our horses compared with the wide openings of the jaw-bones of the Arab horse. The importance of this latter point is seen especially in race horses. The many deaths among modern race horses, supposed to be due to the bursting of blood-vessels, are attributed to the narrow jaw-bones. The heart is wrought to high action in the effort to force the air through the narrow passage, and the result is the breaking of a blood-vessel and death. This was much less common a few generations ago. Another very noticeable difference is the dropping off below the knee of our American horses compared with the big, flat bone below the knee of the Arab horse.

The finer quality of bone that is transmitted by the Arab horse in crossing is one of his greatest values. Beyond this, perhaps, is his ability to stamp eveness and beauty of disposition on his offspring, a quality desired in all horses, especially in cavalry horses. The very close relation that has long existed between the Arab horse and his master, has produced in him a docility and intelligence that is seldom found in horses of other breeds. The prepotency of the Arab is due to the fact that in his veins flows only thoroughbred blood, with no admixture of cold blood, a fact that cannot be said of any other breed.

Organizations and records.

At this time efforts are being made to organize an American Arabian Horse Association, which shall publish a studbook. Arabian horses are now eligible for registration in the American Studbook and in the General Studbook of Great Britain.

Literature.

Roger D. Upton, Gleanings from the Desert of Arabia, London (1881); Lady Anne Blunt, The Bedouin Tribes of the Euphrates, 2 vols., London (1879); Same, A Pilgrimage to Nejd, 2 vols., London (1881); Boucant, The Arab, the Horse of the Future, Gay & Bird, Strand, London (1905). [For further references, see page 416.]

Barb and Turk Horses.

By *Carl W. Gay.*

The Barb horse takes his name from his native habitat, the so-called Barbary states of northern Africa, originally peopled by the Berber tribes. These states are Morocco, Algeria, Tunis and Tripoli. The Barb is the "Horse of the Sahara," of Daumas, the "North African" or "Libyan" horse of Ridgeway. The Oriental group is composed of the Barb, the Turk, and the Arabian, although most recent investigations indicate the Barb to have been the real source of all Oriental blood. A common error resulting in much confusion is the use of the term Arabian in a sense synonymous with Oriental.

Description.

The Barb is fourteen to fifteen hands in height, short of body in proportion to length of limb, his whole form being conducive to speed. The head is beautifully proportioned, with a neat ear, broad, full forehead, large, clear, prominent eye, flashing fire and yet expressing intelligence, a deep jowl with open angle, a trim muzzle and a nostril thin at the margin, capable of great dilation and continually in play. The head is nicely set on a rather long, high-crested neck, well cut-out in the throttle and giving the head a lofty carriage; shoulders well laid-in and sloping, well set-up at the withers; deep, well-arched rib; somewhat drooping croup, although the tail is carried high; straight hind-leg, long pasterns, and rather deep, narrow foot of the most superior texture of horn.

The prevailing colors in Barbary are dark bay, brown, chestnut, black and gray. Ridgeway concurs with other authors in his conclusions that bay with some white markings, as a star or a blaze, together with white coronets, was the original color of the pure Barb. He reasons that the rigid course of selection which modern, scientific breeding has established for the improvement of the race is, incidentally, gradually eliminating all but bays and allied browns and chestnuts, and indicates the final exclusion of all but the bays. Statistics regarding the winners of the principal racing events bear out this conclusion. Thus, as the "blood tells," the bay color predominates.

History.

History first records the horse under domestication in Egypt, and it is thought that his general distribution throughout the civilized world, which took place largely through the agency of the conquests of nations, has been made from this center. Such an indefinite beginning is given a more satisfactory explanation by the modern researches reported by Ridgeway, which he maintains are strongly suggestive that the Egyptians secured their horses from Libya, where they are thought to have been indigenous. This hypothesis has a striking significance in view of the fact that the Libyan horse of Ridgeway is identical with the subject of this discussion.

Zoölogically, there have been demonstrated three distinct species of horses in the genus Equus besides the various species of asses, zebras, and the extinct quagga. To these, Ridgeway adds *Equus caballus libycus*, held by him to be a distinct species or at least a sub-species. This being the case, we are justified in accepting the Barb as the progenitor of all modern light breeds, the Turk and Arabian being derivatives, and not antecedents of the Barb. It is known that horses existed in Egypt 1,500 years before they were in Arabia, a fact that is contrary to the popular belief that the genesis of all good horses was in Arabia. It establishes the Barb as the real origin of the Thoroughbred, the blood influence of which is recognized in all horse-breeding countries. Furthermore, in view of the fact that the Andalusian horse of Spain traces its ancestry across the Mediterranean, the Barb becomes an important part of the native base on which the improvement of horses in America has been made.

In America.—The most notable Oriental horses brought to America are Grand Bashaw, a Barb from Tripoli, whose immediate descendants founded the Clay, Patchen and Bashaw families; Zilcaadi, an Arabian from Turkey, and sire of the dam of Gold Dust; Leopard, an Arab, and Linden Tree, a Barb, presented to General Grant and used by Randolph Huntington in his creation of the Clay Arabian. Most important of recent importations are those of Mr. Homer Davenport, the most conspicuous individual of which is Haleb. (Fig. 460.)

Importance of the Barb.

The importance of the Barb is a matter of history, although it is only recently that there has been much reliable data concerning him available. Much of the early literature has been more or less obscured in mythology and superstition.

Authorities may differ in their views concerning Darwin's theory of the origin of species, but the facts pertaining to the formation and development of those subdivisions of the species called breeds are too well established to admit of any question. These facts show conclusively that the striking contrast in the size, type, conformation, quality, temperament and adaptability of the ponderous Belgian on the one hand, and the racy Thoroughbred on the other, is directly a matter of inheritance, no matter how much the environment may have influenced the two original types from which each respective line of inheritance has been derived. A study of the origin of each of the breeds of horses shows that there were two original sources from which the foundation blood of each breed was drawn. These were the wild Black horse of Flanders, thought to have been indigenous to central Europe from the Rhine river to the Black sea, and characterized by his great scale, grossness, slow awkward movement, sluggish lymphatic temperament, black color and extreme development of hair; and the Oriental horse, native to the desert regions of northern Africa, Turkey, Asia Minor, Persia and Arabia, the most notable characteristics of which were extreme refinement and breediness, beauty of form, spirit and intelligence, speed, stamina and grace of movement, and an active nervous temperament. The breeds of the heavier, draftier type show a preponderance of the characters of the former, while those of the lighter, speed type resemble more closely the latter. The so-called coach breeds represent a more or less proportionate blending of the two.

Use.

Some idea of the extent to which the Oriental blood has proved a potent factor in the foundation or improvement of modern breeds may be had from a review of the origin of some of them. The term Oriental is used in this connection for the reason that earlier writers were not specific in their references to Barbs, Turks, or Arabians. The Darley

Arabian, Byerly Turk and Godolphin Barb, with the "Barb mares," have been called the real foundation of the Thoroughbred. The Percheron owes his origin to the mating of Oriental horses, left by the Saracens or brought back by the Crusaders, with native French mares of the Flemish blood. Subsequently, there were made at intervals systematic top crosses of blood from the Orient. Gallipoli and Godolphin were two of the most important of these, and the former is regarded as the most influential sire in the history of the breed. The prototype of the Hackney, the Norfolk trotter, was the result of a Barb union with the Black trotter of Friesland. The Cleveland bay was the product of a Barb-Yorkshire cart horse cross. The hot blood of the desert is mentioned in connection with the origin of the German coach horse. Bars 1st, progenitor of the Russian Orloff trotter, was three generations removed from Smetanka, a gray Arabian taken into Russia. The Prussian Trakehner is derived from an admixture of Oriental and Thoroughbred blood with the native stock. [See further under *History in America.*]

There is some question as to the value of this Oriental horse to the breeder of the present time, although its importance as a foundation stock is so well demonstrated. For example, the Thoroughbred is an improvement over his Oriental ancestors as a race horse, and fresh infusions of the blood are generally regarded as detrimental. Furthermore, no increase in trotting speed can be expected to follow crosses of the Oriental blood on our American Standardbred trotter. Nevertheless, there is an active demand in the markets of today for a horse that is neither a running race horse nor a trotting race horse, but a harness type. In this horse, a pleasing appearance and good manners are as valuable attributes as speed, and to this end beauty of form, symmetry, quality and finish, style and a pleasant, tractable disposition, are essentials that offset extreme speed. It is as a source of these desired characters that the Oriental horse finds a place in meeting modern market demands.

Organizations and records.

Barbs are registered in The Algerian Studbook, a book of record recognized by the United States Department of Agriculture. It is said that the number of English and French horses in Algeria has led to the Barb being more extensively crossed with this blood than in Morocco, where there are fewer foreign horses, and systematic efforts have been made under the direction of the Sultan to keep the blood pure. Some Barbs are also registered with Arabians in the General Studbook of Great Britain.

THE TURK HORSE.

This horse, named with the Barb and the Arabian as constituting the so-called Oriental group, has much less significance than either of his contemporaries. Sanders suggests that the horses of Arabia and Persia were originally derived from Turkey. In the light of recent investigations we are led to conclude that the term Turk does not imply any particular stock, but designates merely the horses of Turkey. These have been of a different character at different periods. The originals, called Turcoman, were probably offshoots from the pony types native to the mountainous districts of southern Asia. They were first reported in Turkestan, but became generally distributed later in Turkish Asia and Persia; there are few horses in Turkey in Europe. These original ponies do not represent the Turk as he is referred to in recent times, however. Their type has been so completely modified by the Arabians with which they have been crossed as to leave little evidence of their former characteristics. However, plain heads with Roman noses, ewe necks, light middles and long legs are still noticeable, and are charged to the Turcoman foundation. These modified Turkish horses are of fair size, bay, black or gray in color, with uniform white markings. In those parts of Turkey nearest the Arabian border, many pure Arabians are found. Captain Hayes reports that the horses in ordinary use in Turkish towns at the present time are small, hardy animals, grey or bay in color, and are produced by Arabian stallions out of Kurdistan pony mares, the latter being similar to the Turcoman ponies already referred to, and typical of the horses indigenous to Turkey. Probably the best Turks, so-called, were not Turks at all, but Arabians or Barbs.

Literature.

E. Daumas, The Horses of the Sahara, London (1863). [For further references, see page 416.]

Belgian Draft Horse. Fig. 461.

By *W. L. Carlyle.*

As the name suggests, this breed is developed for draft purposes. It has little value for any other purpose, being of a sluggish temperament, although very powerful.

Description.

The Belgian draft horse is one of the most compact in form of any draft breed found in America, possessing a maximum of weight with very short body set on short legs. The form is broad, massive and well proportioned, as a rule. In quality, it is somewhat lacking, the legs appearing round and rather coarse. The tendons of the legs are large and not well defined. The skin is sometimes fine, although the hair is occasionally rather coarse and inclined to curl. The head is of good size, the nostrils are large and the eyes small and not very prominent. The ears are small, set wide apart and generally are not well carried. The neck is short, very thick and well crested. The shoulders are upright, strong and heavily muscled. The chest is deep and wide, giving a very large girth. The ribs are long, well sprung, and closely ribbed up to the hip, giving a better barrel than is found in any other breed of draft horses. The back is short,

very broad and inclined to sag somewhat more than is desired. The loins are wide, short and very thick. The flank is low and full. The hind-quarters are inclined to be short, very wide and muscular, and the tail is attached somewhat low and not well carried. The lower thighs are usually very wide and well muscled. The hocks are round, not clearly defined and too "meaty." One of the serious faults the American horsemen have found with this breed is in the character of the bone of

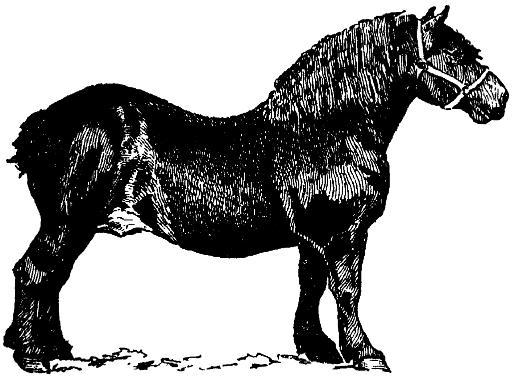


Fig. 461. A Belgian stallion

the legs, particularly with the hock joints. The feet also receive rather severe criticism, as the hoofs are inclined to be small, narrow and very high in the heels, predisposing to side-bones and contracted feet. In action, the Belgians are inclined to stumble at the walk, but trot off freely and with apparent vim and spirit. In color, the chestnut and roan are most common, although brown and bay are frequently found. The grays are not in favor, although occasionally one is seen.

In Belgium, these draft horses are classified somewhat according to the sections of the country in which they have been bred. Those from Flanders are the largest and those from Ardennais district the smallest, while those from Brabant are of medium size and weight.

History.

In the early history of the Belgian breed of draft horses, no particular animals appear to have been prominent nor has any breeder of outstanding merit appeared. This breed, unlike most other draft breeds that have been developed, has been almost entirely the product of its environment. The small country of Belgium has a reputation as the home of draft horses extending back through several centuries. Many, if not all, of the draft breeds of Great Britain and France were greatly improved during their formative period by the use of the heavy Flemish horses, the early progenitors of the Belgians. Modern horse-breeding in Belgium, however, is comparatively recent in its greatest activity. A revival of the interest in horse-breeding in Belgium was greatly stimulated and developed with the establishment of government breeding studs in 1850. The Belgium government annually sets apart about $75,000 for the supervision and encouragement of draft-horse breeding in that country. By a system of prizes, and financial encouragement of individual breeders, as well as of the National Draft Horse Society of Belgium and the local fairs, it has had a very potent influence in the development of this breed. By every means, the government seeks to encourage the best efforts of individuals, and to discourage the exportation of desirable animals. The city of Antwerp, in Belgium, is noted throughout the world as possessing many of the finest specimens of draft horses to be found, and these horses are without exception of the Belgian breed.

In America.

The history of this breed in America is comparatively brief. The earliest importation was probably in 1886, when a few horses were imported into Illinois by Dr. A. G. Van Hoorebeke. They were at that time incorrectly termed "Boulannais." Since 1887, large numbers of Belgian draft stallions have been imported into the United States and have been found exceedingly valuable for crossing on native grade draft mares. In 1888, Mr. E. Lefebure began importing and promoting the interest of the breed in this country. One of the first firms to import these horses was D. P. Stubbs & Sons, of Fairfield, Iowa. Since 1897, there has been a large and constantly increasing demand for stallions of this breed. The leading importers have been A. B. Holbart and Lefebure & Sons, of Iowa; J. Crouch & Son, of Indiana; McLaughlin Bros., of Columbus, Ohio; Dunham & Fletcher, of Illinois, and H. A. Briggs, of Wisconsin. Very few mares have been imported into this country for reasons that are not well understood. This is due partly to the fact that there is not the demand for the Belgian breed to encourage importing and breeding, as the trade is better satisfied with the Percheron and some of the English draft breeds; and partly because of the very high prices asked for Belgian mares abroad.

Distribution.

The Belgian draft breed of horses had no wide general distribution outside of its native home, until within the past ten years, since which time it has had a wide distribution on the continent, as it is particularly desirable for use in the heaviest kind of work in large cities. Numbers have been imported into Germany, France, Holland, Sweden, Austria, and other European countries, the Argentine Republic, and other South American countries, and to the United States, where they have had a wide distribution, particularly in the central states.

Feeding and care.

In its native country, the Belgian draft horse is given the best of feed and care to produce a maximum of size and weight as early in life as possible. The foals on the best farms are born early in March or April, the dams usually doing all of the farm work. The foals remain in the stables during the day, and a number of them together in one inclosure if possible. While the mares are at work, the foals

are fed liberally on a sloppy mixture of equal parts of crushed oats and bran and sufficient water to form a thin gruel. They are also supplied with fresh drinking-water at all times and with an abundance of good green clover and grasses. At night they are turned into rich pasture lots with their dams. They are weaned at four or five months of age, very little change being made in their feed, and they are allowed to eat all they will consume of bran and oats, and of green clover and hay. They are turned into grass lots at night and confined to darkened stables during the day. This system of feeding is followed until they are three years of age, when they are broken to work. Since most of their feed is green and succulent, it is thought that this is responsible for the great depth of barrels of the Belgian horses, and to some extent for the soft bone and poor quality of feet.

Uses.

For draft. As has been said, these horses are bred entirely for draft purposes, and they rank well among the heavy breeds, especially in Europe. The short, stocky legs, and low-set blocky body, make them very useful for slow, heavy hauling over city streets.

For crossing.—Belgian draft horses are especially adapted for crossing on grade draft mares, lacking in weight and substance, for the production of heavy draft horses. When crossed on grade Percheron or Clydesdale mares, they impart an increased depth of body with a comparative shortening of the legs, and a general massiveness of form not easily secured by the use of any other breed of draft stallions.

Organizations and records.

The National Draft Horse Society of Belgium (Le Cheval de Trait Belge) was founded in 1886, and the American Association of Importers and Breeders of Belgian Draft Horses in 1887. The former association has issued a number of studbooks, and is very aggressive in the interest of the breed. It receives national financial support. For twenty years the latter association did very little to encourage the breed, which accounts, in part, for the little interest taken in these horses in America until within recent years. It is now more active. The first studbook was issued in 1905.

Literature.

For references, see page 416.

Cleveland Bay and Yorkshire Coach Horse. Figs. 462, 463.

By *John A. Craig.*

The Yorkshire coach horse is an outgrowth of the Cleveland Bay coach horse, conceded to be merely an improved type. The two are so inseparably associated that it is deemed best to consider them together. In fact, in America, they are considered to be one breed and are registered in the same studbook.

Description.

In the Cleveland Studbook (British) there is the following description of the Cleveland Bay horse which, in addition to being very accurate, is also official: "From sixteen hands one inch to sixteen hands two and one-half inches in height he should be possessed of good, sloping shoulders, a short back, powerful loins, and long quarters. His head

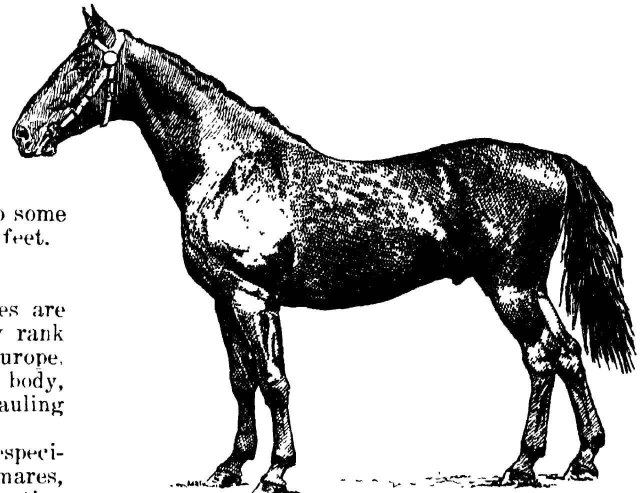


Fig. 462. Cleveland Bay stallion. Special Delight.

is rather plain than otherwise, and on the long side, but it is well carried, and his general appearance denotes strength, combined in a manner not seen in any other light horse breed. His action is not specially high, but it is the kind for getting over the ground. In color he is bay—either light or dark—with black legs clear of hair; and black, zebra-like stripes on the arm and above the hocks are sometimes seen. These are known as the black points and are supposed to denote special purity of breeding. White, save a small star or a few white hairs in the heel, is not admissible, a blaze or white foot proclaiming at once the admixture of foreign blood."[1] An early writer[2] makes the following comment on the old stamp of Cleveland Bay, just about the time the Thoroughbred was to be used most liberally: "Very many of the Cleveland horses are disfigured by having large heads and Roman noses; and it is only when these parts are, to a certain extent, concealed by the winkers of the bridles and the trappings that adorn them, and their heads are borne up by the bearing rein, that they acquire the imposing appearance which, when well matched, so many of them possess. When stripped, a great proportion of them appear a very different sort of animal indeed, and, in all probability, a smaller and more compact sort of horse would go through double the quantity of work that they are capable of enduring. Fashion, however, is to be consulted by the breeder, to a certain extent; and, so long

[1] Wallace, Farm Live Stock of Great Britain.

[2] John Burke, Royal Agricultural Society Report, Vol. V, 1844.

as he can obtain from job masters a large sum for a pair of these overgrown animals, he will do well to breed them without reference to their being unequal in point of endurance to a smaller and better-formed sort of draught horse. It is generally supposed that a horse destined for harness should not have a very oblique shoulder, as when so formed he is not capable of throwing so much of his weight into the collar as when his shoulders are more upright; but it must be remembered that grand and lofty action is highly prized in London for the purpose of show, and not for hard work, and hence a sloping shoulder is a point to be desired by the farmer who breeds carriage horses for the London market; for, as I have already observed, it is one which is mostly accompanied by high action."

In the latter part of the nineteenth century, after the organization of societies in the eighties, to promote this breed, the British public became

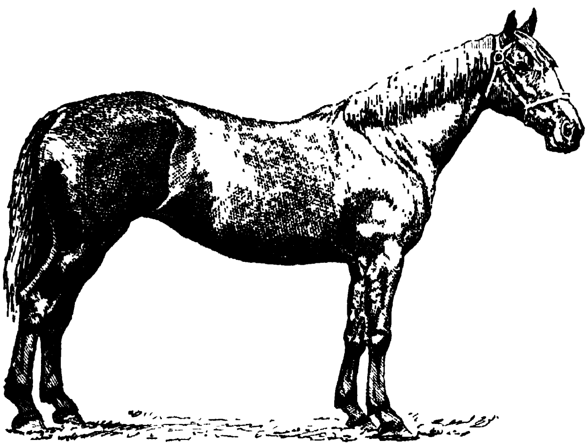


Fig. 463. Cleveland Bay mare. Queen Dearest.

interested in the horse to supplant oxen on the farm. At this time, too, the demand changed from a very heavy carriage horse to a lighter horse with more quality, more style and more coach or high action. The Cleveland had to veer one way or the other or become extinct. It is evident that it was changed towards the latter largely by the greater use of Thoroughbred blood, and that resulted in the type more commonly known by the name of the Yorkshire coach horse. To indicate the tendency of the change, the following extract from the Yorkshire Coach Studbook will be of service: "It cannot be claimed for the Yorkshire coach horse that he is a pure-bred animal, but that, on the contrary, by the judicious crossing of large-sized good-colored mares with stallions altogether or nearly Thoroughbred, a class of horses has been produced suited to the wants and circumstances of the times. By universal consent, the color should be bay or brown, with black eyes, mane and tail abundant but not curly, the height from sixteen hands to sixteen hands two inches, with fine head, sloping shoulders, strong loins, and lengthy quarters, high-stepping action, good sound feet, flat legs and abundance of bone and muscle."

History.

Perhaps the best evidence we have of the ancient origin of this breed is the prevalence of so many theories as to the foundation from which it started. Martin Doyle, writing in 1843, asserts that it is descended from the old war horse of Great Britain. There are other authorities, also, who state that this breed has the best claim to the distinction of being related to the horses that pulled the war chariots of the early Britons when Julius Cæsar invaded England. As a matter of fact the first records of the Cleveland horse connect it with being a pack or Chapman horse.

It is historically certain that the breed originated in Yorkshire, one of the northern counties of England. The conditions of Yorkshire were eminently suitable for the production of superior light horses. The people were horsemen, and the fertile valleys and hills, underlaid in the best grazing districts with limestone, were very productive of nutritious grass.

No specific reference to the Cleveland breed is made by any of the earliest writers. The first distinct reference to the Cleveland seems to be that made by George Culley, in his "Observations on Live Stock," published in 1801. In this reference, Culley originates the theory that the Cleveland Bay horse is the result of the mixture of the Thoroughbred with the cart horse, a theory which some writers combat so far as to say that neither the Thoroughbred nor a heavy strain like the old cart horse had anything to do with the formation of the breed. One authority[1], who takes unusual pains to substantiate the war horse theory of Cleveland Bay origin, goes to considerable length to disprove the introduction of either cart or Thoroughbred blood, and this he has failed to accomplish, as he has been forced to acknowledge that "Probability points to a Thoroughbred Traveller as having had something to do with imparting fresh quality and courage to the Cleveland Bay" The straight croup or level hind-quarter is a decided Thoroughbred characteristic, and it is a trait that most other breeds of light horses tend towards when much Thoroughbred blood is used, as has been found in the instance of both the Hackney and the French coach horses. It is a matter of record, too, that Dunsley's Dart, one of the three sires that seem to have had most to do in establishing the Cleveland as a breed, goes back to the Darley Arabian, and the preface to the Yorkshire coach studbook so states. The old Cleveland Bay, the horse that was so popular in early days for heavy coaches and for matched teams for the London market, may not have had very much Thoroughbred blood in it, considering the amount that has been used later.

The best early history of the county of Yorkshire appears in three separate prize essays by different writers, published in the ninth volume of the Royal Agricultural Society (England) Report,

[1] Light Horses: Breeds and Management.

published in 1848, from which the following reference by George Legard is taken: "Formerly, a large, powerful, bony animal was required for carriage purposes; the fashion of the present day has, however, changed this particular, and now it is necessary that the London carriage horse should be at least three parts Thoroughbred. Consequently, all traces of the original pure coaching breed or Cleveland Bay, as it was termed, are nearly obliterated." Another writer on Yorkshire in the same report, page 518, says: "The Cleveland, as a pure-bred, is losing something of its distinctiveness. It is running into a proverb that a Cleveland horse is too stiff for a hunter and too light for a coacher, but there are still remnants of the breed, though less carefully kept distinctively than may be wished by advocates of the breed."

Other causes, too, were operating to change the type of the breed and encourage the more liberal use of Thoroughbred blood. One of these was that the abundant grass-land was converted into tillage-land. The high price of grains, due to the war, induced an unusual activity in farming, and a heavier horse was called for. The coal industry also demanded a heavier horse. Again, the use of the horse on the road, because of lighter vehicles, called for a lighter horse, so that, in a multitude of ways, the old type of Cleveland was undergoing dissolution. When the outlook seemed darkest, the American trade opened up, and, in 1884, the Cleveland Bay Horse Society was formed, and a studbook established. At this time Thoroughbred blood was used very liberally. So much stress would not be laid on the Thoroughbred blood introduced, if the writer did not believe that all our recognized breeds of light horses have more or less Thoroughbred blood in them, and all are, as a consequence, rooted deep in Oriental ancestry, chiefly the Arab.

In 1889, the Royal Agricultural Society recognized the Cleveland Bay as one of the distinct breeds of English horses, and offered prizes for it, although it was shown with the Yorkshire Coach. At the meeting of the societies, in York, as early as 1848, a few Clevelands were shown.

In America.—It cannot be said that the Cleveland Bay or Yorkshire coach horse ever had the popularity in this country that has attended the importation of some of the other breeds of light horses. Those that were imported were considered unusually good representatives, but the type and breed-characteristics never found much favor. In coach or carriage horses, high and attractive front action with good hock action are essentials, combined with a stylish, smooth and symmetrical appearance, associated with quality in all parts. In these respects, the Cleveland Bay did not approach the excellence shown by other breeds.

Distribution.

The Cleveland Bay horse has enjoyed some popularity, notably in South Africa. Aside from importations into America, the horse has been taken to South America, Australia and Sweden.

Enough has been said to indicate the place of the Cleveland Bay as a coach horse. It has found some favor as a roadster, especially in England. These horses are very uniform in color and markings, and they are very prepotent in transmitting these characters when crossed on common mares. Because of this their get is uniform and easily matched into teams. Their size and power and disposition adapt them for some of the work of the farm better than is the case with any of the other breeds of light horses; but, owing to their deficiency in quality and action, they have not been generally popular in American horse-breeding districts.

Organizations and records.

There are two studbooks in England, that of the Cleveland Bay Horse Society and that of the Coach Horse Society, devoted to the Yorkshire Coach. In 1885, the Cleveland Bay Horse Society of America was organized, which registers both the Cleveland Bay and the Yorkshire Coach. The headquarters of the society are in West Orange, N. J. It has published two volumes of its studbook.

Literature.

For references, see page 416.

Clydesdale Horse. Figs. 464, 465.

By *John A. Craig.*

This breed has been known for many years as the draft breed of Scotland. It is one of the oldest breeds of British draft horses.

Description.

Clydesdales have a kind, quiet disposition, good courage, and enough spirit. A weight of 1,700 to 2,000 pounds for stallions and 1,500 to 1,800 pounds for mares, with an average height of 16½ hands for the former and 16 hands for the latter, may be regarded as the standard for mature, well-developed individuals of this breed. The characteristics of the modern Clydesdale, in reference to color, vary somewhat, the most prevalent being bay, brown, black or occasionally chestnut, with white markings on the forehead or face and below the knees and hocks. They vary more in characteristic markings than most of the other draft breeds, but in uniformity of type there is a striking similarity among the best. The head is almost invariably intelligent. The shoulder is exceptionally good, which gives a free, easy, long stride. It is somewhat oblique, accompanied by high withers. The arm is usually well muscled, and the bone clean and flat. The feather (hair on the legs) in horses of the best quality, springs from the edge of the bone, and is fine, silky and long. It is not considered of much importance in itself, but is valued for what it indicates. The assertion is made that a proper feather protects the coronet and back part of the pastern from filth and mud, and, consequently, is preventative of scratches. It has often been objected to in America. At any rate, the feather, when fine, indicates that the other

tissues, the bone and skin, are also of fine texture. Conversely, when the feather is wiry and coarse and curly in this region, it surely denotes a leg predisposed to grease or scratches. The pastern and feet have been vastly improved in this breed in recent years, owing to the demand for more slope and length in the former and larger hoof heads in the latter. The same is true to a degree in regard to the coupling, which at one time was considered the weakness of the breed, attributable to the lack of depth in the shorter ribs. Increasing the depth of body and adding to the length of the hinder ribs have been effective in lessening the prevalence of this criticism. The croup of the Clydesdale is muscular, and the quarters are specially well developed. The set of the hocks is one of the strong points of the breed. A properly set hock forecasts pulling power, and it also implies freedom from curbs and from coarseness, due to thoroughpin or bog spavins. With the web of the hock free from any filling, the latter works freer and stronger, and is not predisposed to diseases ; and such a hock is almost invariably properly set, for it will frequently be noticed that it is the straight hock that is more "meaty" and subject to bog spavins and thoroughpins. Properly set hocks, above all other things, insure the hock action which is so greatly sought in Clydesdales. To bring the hocks well under the body and not to spread too much in passing each other are very desirable attributes, and these are eminently characteristic of the Clydesdale's hind action. The front action in best form is free, snappy and folding at the knee, chiefly attributable to a shoulder of correct slope, and springy yet strong pasterns.

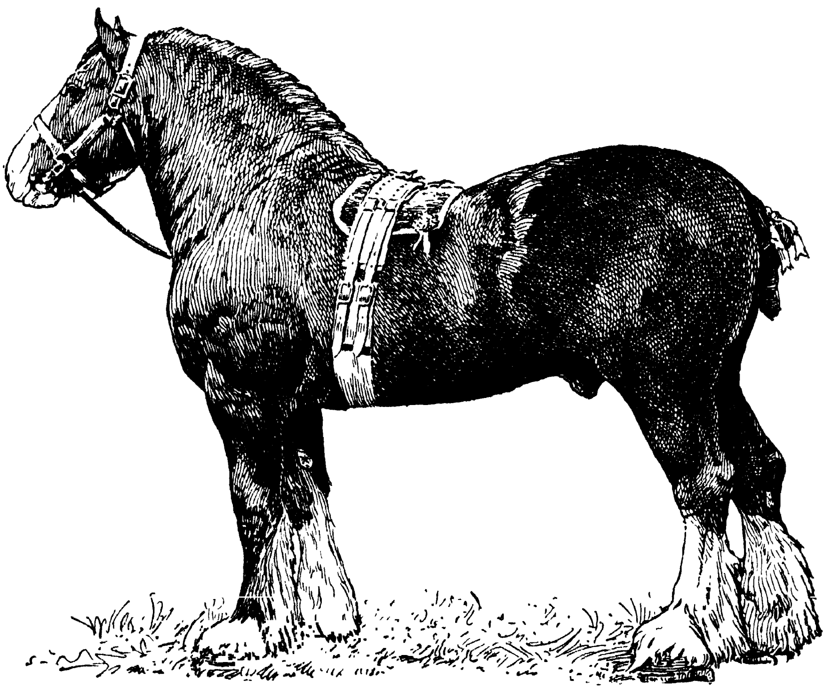


Fig. 464. Baron's Pride. Said to be the greatest Clydesdale sire in the world. Owned by A. and W. Montgomery, Scotland.

History.

The Clydesdale originated in the lowlands of Scotland, with the county of Lanark as the chief center of activity in producing the breed. It is frequently referred to as the Clydesdale district, and is divided throughout its length by the Clyde river. While the lowlands of Scotland have long been noted for the heavy horses bred there, yet it was not until the latter part of the eighteenth century that the breed was much improved by the importation of some heavy stallions from Flanders. John Paterson, of Lochlyoch, is said to have imported the first Flemish stallion for this purpose early in the eighteenth century. The Flemish stallions were large-boned and heavy horses of sluggish temperament, with slow, awkward action. The lowlands of Scotland are very favorable for the breeding of heavy horses, as the soil is fertile and the pasturage luxuriant; and these, with a suitable climate, have a marked effect on the characteristics of the modern Clydesdale, as they are favorable for growth of bone and muscle, giving both height and substance.

The Clydesdale of today is the result of careful and persistent breeding for definite ends. The results of the breeders' efforts in a general way may be summed up by stating that they have ultimately been very successful in combining weight, quality and action as the prime essentials of a draft horse. These, successfully united, produce a draft horse that has pulling power, wearing quality or endurance, in association with ability to move properly at a satisfactory pace, either walking or trotting. The evolution of this breed of draft horses is more than usually interesting because of the decided views of the home breeders and the singleness of purpose which they have shown. The progress has been secured through concentration on one feature after another, until it produced the desired results. Without government direction or aid to secure uniformity of progress, it is safe to say that the Scottish breeders have accomplished as marked improvement in their draft horses as the breeders of any other nation, and the modern Clydesdale of accepted type possesses inherited characteristics so fixed by consistent breeding that they are likely to be passed on to succeeding generations. Archibald MacNeilage, secretary of the

Clydesdale Horse Society of Scotland, in a review (Famous Clydesdale Sires, Transactions of Highland and Agricultural Society, Vol. IX, 1897) of the most noted Clydesdale sires from Champion to MacGregor 1487, shows the evolution of a type from a coarse prototype, which the author describes as being a horse of weight with plenty of strength of bone, but not at all "right at the ground" in the modern sense, nor as "sweet" in his limbs as horses are liked now.

For a century the Clydesdale breeders in Scotland worked without results that were striking on the surface, but when this cycle had passed, the evolution of such sires as Prince of Wales (673) and Darnley (222) had crowned their efforts. The former is credited with possessing style and action in an unusual degree, and these qualities were very desirable to graft on to the breed at that time. But with the production of Darnley (222), a sire possessing the true balance of qualities which mark the serviceable draft horse, with the power to reproduce these, the Clydesdale breed received an impetus that effectively disarmed the old-time criticism of "light middles." From the Prince of Wales line have come Prince of Albion (6178), said to be the highest-priced two-year-old draft horse ever sold, he bringing £3,000. He was, in turn, the sire of the two-year-old filly, Queen of the Roses, with a similar record, she bringing £1,000. Also, from the Prince of Wales came Cedric (1087), exported to Scotland from the stud of Col. Robert Holloway, Alexis, Illinois, one of the leading importers of Clydesdales in America. From the Darnley line have come MacGregor (1487), Baron's Pride (9122) (Fig. 464) McQueen (3513); and in such as these the Clydesdale breeders secured that combination of substance, quality and action, with right set of legs, for which they had striven long and assiduously. Beginning with a prototype coarse and weighty, it was refined without loss of substance; and then by concentrating their attention successively on style, action, set of legs, slope of pasterns, through years of criticism and discussion, the Clydesdale of today emerges with the characteristics desired very pronounced, and in addition, equipped to transmit them.

In their adherence to quality, meaning thereby texture of bone, cleanness of joints and fineness of skin and coat and feather, the Scotch breeders made no mistake in so improving the breed at an early day, for it has not only added to the appearance of the individuals, to free them from the charge of grossness of joints and coarseness of bone, but it has also added materially to their durability under the strain of steady service. Fineness of feather and sloping pasterns seemed fine fancy points to the uninitiated, but a steady demand for them improved the quality of the Clydesdale at a rapid rate. The breeders previous to this had concentrated on action with a zeal that has hardly been equaled by the breeders of any other breed of horses. The demand became insistent for action in show and breeding stock, and the result is that, in the possession of this feature, judged from a purely mechanical standpoint, the breed has made marvelous progress. The action required had to be straight, regular and free, both at the walk and at the trot, with a free flexion of the knee, a springiness to the pastern and a straight and close passage of the hocks. In the effort to secure these improvements, the Scotch breeders were very ably supported by the American breeders, although the latter did not feel like going so far in the securing of quality as the home breeders. It is very likely that the latter felt some misgivings on the point, for there is no doubt but that the slight infusion of Shire blood, which was made into the Clydesdale, chiefly through the use of Prince of Wales (673) blood, is, to some degree, evidence that they wished to regain some substance and weignt, which, for the time being, had been sacrificed to a degree for quality.

The Clydesdale breeders ultimately secured what they had striven for, even though little attention has been paid to the American dislike for splashes of white on legs or body. In this connection it may be given as a general principle that while it is well to bear in mind the peculiar requirements of any trade, yet it is well to be careful in the matter of humoring any fad as to color or any other fancy point, when it clashes in any way with real essentials. Having secured the latter, then the question of markings and color may properly be allowed to enter as a substantial factor. Another feature is that the history of the live-stock trade in this country indicates that to cater to a color, especially of a fad, has its dangers. The preference for red among Shorthorn admirers carried to the point of a prejudice against the roan, has reacted, although not until the breed had suffered as a consequence. The Percheron breeders submerged the old gray

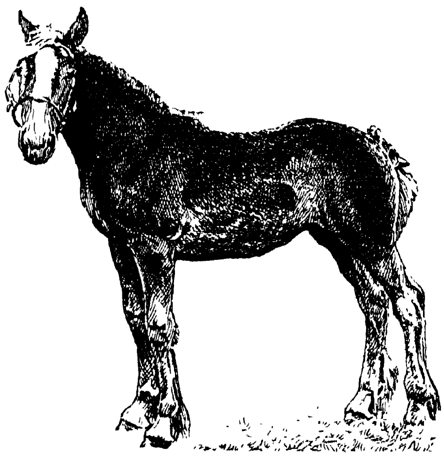


Fig. 465. A Clydesdale filly.

Percheron and gave preference to the more modern black in answer to American preference, and now that the demand of the draft-horse market in this country is said to place a premium on grays, the breeders will have to swing back if American preference is to be recognized. Uniformity of color and attractive markings are admitted by every one to be desired, and the Clydesdale is the sufferer for bizarre markings.

In America.—The first importations were made into Canada in 1842, when Archibald Ward, of Markham, Ontario, imported Grey Clyde, 78; three years later, R. Johnson, of Scarborough, Ontario, imported Sovereign, 181. Other importations were made into Canada in 1850–51–54. About twenty years later Clydesdales were imported to the United States, both directly from Scotland and from Canada as well. The largest importations were made after 1880, and in the following twelve years many thousands of both sexes were brought to America. They are now widely distributed, and generally known and used.

Distribution.

The adaptability of the Clydesdale, has led to a wider distribution of it than of any of the other draft breeds. It has found favor in the leading English-speaking countries, including, in addition to the United States, Canada, Australia and New Zealand. The Argentine Republic has imported many of the best, while several of the European nations, notably Germany, Sweden and Russia, have been most active in making importations. It has also found its way into South Africa. On this continent, the breed has been most popular in Canada, and the good effects of the use of this breed in grading up farm mares to produce drafters serviceable on the farm and marketable on the best markets, may be seen on almost any Canadian farm, while on the streets of the large Canadian cities, such as Toronto, Hamilton and Winnipeg, the teams attached to the lorries, showing in their characteristics Clydesdale breeding, will compare favorably with any others doing like service under similar conditions.

Uses.

For draft.—The Clydesdale is essentially a draft horse, bred for that purpose alone. His free, straight, rapid gait, and strong, heavy frame, give him high rank among draft breeds.

For crossing.—Good types of pure-bred Clydesdales on native draft mares have given grades with considerable snap and power, well adapted for medium draft work in the city and on the farm.

The secretary of the American Clydesdale Association has reported the sale of four draft geldings, largely of Clydesdale breeding, on the Union Stock Yards market for $3,200, to Nelson Morris Company. Sales by private treaty are not reported to the extent that auction sales are, but this, however, is considered to be a record price on the Union Stock Yards' market. It is, in a degree, an index to the merit attainable by horses of this extraction for draft purposes.

Organizations and records.

In 1877, the American Clydesdale Horse Association was formed to look after the interest of this breed in America, and up to 1907, about 15,000 registrations had been entered, there having been over 1,000 entries during the past year. The Scotch Clydesdale Horse Society was organized in 1878, and it has a registration of over 30,000 stallions and mares. Each of these associations issues a studbook, the American Association having published thirteen volumes and the Scotch Society twenty-nine volumes. The headquarters of the American Association are in the Union Stock Yards, Chicago.

Literature.

For references, see page 416.

French Coach Horse. Fig. 466.

By *John A. Craig.*

The name "French coach" originated in America, and it is here the official designation of this breed of coach horses, although it is not in use in France, where the name "Demi-Sang" prevails.

There has always been a strong demand in most of the horse markets of the world for high-class coach or carriage teams. The fact that carriage teams of right type and action bring unusually high prices in the horse markets has always been a strong stimulus for their production. This of itself has led to the development of breeds suitable for the production of such horses in several countries, but an additional stimulus was added to the production of the French coach through the French government being actuated by the desire to supply its army with the best remounts. The wisdom of this has already accrued to the advantage of the private individual, for superior carriage horses are always at a premium, and it remains for a war to bring to the attention of other nations the superior foresight with which France has provided for her cavalry and other army corps in the matter of remounts. It is a national work, the matured fruit of which will be fully apparent only in a national crisis when most needed.

Description.

Coach type.—The French coach horse of the coach or "carrossier" type is in every essential a coach or carriage horse according to the market requirements. These horses stand, on an average, sixteen hands high, and in weight may vary from ten to fourteen hundred pounds. Most of the horses of this type are upstanding, carrying their heads and tails high when in motion or at rest. They are smooth, symmetrical and invariably of fine quality, with very graceful movement, having high and bold knee action, with regular, uplifting, hock action. They have intelligent heads, graceful necks, snugly ribbed bodies, and muscular quarters. If any part of the conformation might be chosen as fit for general criticism, it would be the legs, although these, in most instances, are well set and have every evidence of quality. There is an airiness and gracefulness about a well set-up French coacher that is hard to find in any other coach breed. It is due chiefly to their unusual length and gracefulness of neck, in conjunction with a spirit of alertness in movement or statuesqueness in standing which, besides being due to bodily conformation, is also traceable to the excellent training they receive to show their qualities to the best

advantage. The common colors are bay, brown or black. Considering the mixed breeding followed in evolving the French coach, it is exceptionally uniform in type, a result due likely to the uniformity in the standards of the men who as directors have control of the government breeding operations. The greatest success in producing the most handsome and stylish carriage or coach horses has been by using mares approaching as nearly as possible the type desired, with as much quality and action as possible.

The trotting type.—The production of the trotting type for many purposes has been encouraged since 1836, when the French government began offering prizes for trotting races, with the special object of encouraging long-distance trotting, more especially under the saddle. The races are usually for distances varying from two to three miles, and are run over sod ground. The records are established by the kilometre, which is about five-eighths of a mile, without reference to whether the race extended one or three miles. They are made under saddle from a standing start and carrying not less than 120 pounds. As might be expected, those of the trotting type are racier in appearance, being somewhat like our own trotters, finely drawn, more angular than the coach type, rangier in appearance and somewhat better in quality. A horse of stamina and substance, as well as speed, is required, for it is to be remembered that the races are for long distances over turf, which demands strong, bold going and powerful action. [Speed records and races are discussed on the following page.]

History.

In the latter part of the seventeenth century, the French government, by establishing the Administration des Haras, began the systematic improvement of their horses, and as early as 1690 there were 1,600 stallions known as "royal" or "approved." During the many years of disturbance in France, changes of government and national reverses, the work has gone steadily on to the present day. In 1789, there were 3,239 stallions in the government service, and at the present time provision is made for the maintenance of 3,300 government stallions, mostly kept in that part of France west of Paris, and particularly in the province or district of Normandy. It is in this section that the breed has had its greatest growth, and it was because of this that some of the earlier importations were called Anglo-Normans. In 1833, a studbook was established, and in 1870 the department of agriculture was given control of the government horse-breeding interests under the supervision of a director general and staff of inspectors. The government control is exercised in a way very similar to that described in discussing the Percheron, except that the government, in the case of the coach horses, does most of the breeding, and consequently branded stallions among the French coachers are not so common as among the draft breeds. According to the report of the Director General for 1903, about fifteen hundred stallions owned by private parties were approved and authorized. The same classes are made as in the case of the draft breeds, there being (1) the stallions in the government service, (2) the stallions subsidized to the extent of $100 to $1,000 yearly while approved, and (3) the stallions authorized for public patronage. All others are prevented by a law passed in 1885 from standing at public service, although any owner, at his discretion, may use such for private purposes, a practice that is not encouraged.

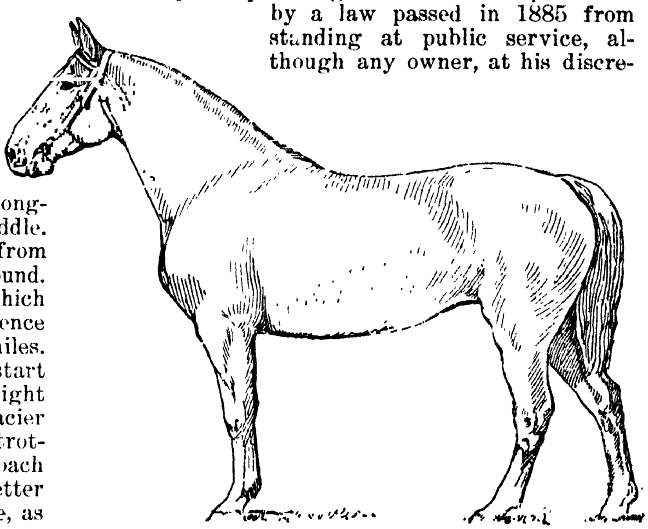


Fig. 466. French coach mare. Modjeska 2194.

In the breeding operations of the government, a great variety of sources are drawn on. Thoroughbreds have been very extensively imported from England since the early days of the breed, and Hackneys have been freely imported and liberally used; in the inception of the breed, twenty to thirty Hackneys were imported annually. Heavy importations of Arabians and others from the Orient, have been made, particularly in the early stages of government control, and even stallions of American breeding have been used. Niger, whose record is quoted elsewhere as among the best, was sired by the Hackney stallion Norfolk Phenomenon, and had an American-bred mare for his dam. Descendants of Norfolk Phenomenon were a popular line of breeding, and enter largely into the pedigrees of many of the Demi-Sang. Another stallion that had considerable to do with the better type was Aemulus by Mambrino Pilot, and out of a Morgan-bred mare, Black Bess, consequently representing one of the old strains, common among our Standardbred trotters. This is mentioned to indicate further the variety of sources drawn on for foundation stock. In the production of trotters among the French coach horses, one stallion, Fuschia, holds about the same relation to the breed as Hambletonian 10 does to that of our American Standardbred trotters, in the extent to which the blood of each predominates in the respective breeds.

In America.—The French coach horse was most extensively imported to this country during the eighties, many of them coming to the eastern states.

Those sent west were most largely taken to the states of Illinois and Ohio. In the middle west they have been liberally patronized, and when the foundation mares were of suitable size and type, and a fair degree of action, high-class carriage horses have been produced. The scarcity of the proper type of mares to breed to such stallions militated against the reputation of the breed for crossing purposes ; and especially has the scarcity of genuine coach action been the source of some disappointment.

Distribution.

The French coach horse has been imported into many parts of Europe and America, but has not been bred systematically on a large scale in many parts of the country. As has been said, it is found in America chiefly in the eastern states, Illinois and Ohio being, perhaps, the leaders.

Types.

Owing to the needs of the army, the French coach horse in France is represented by two types, referred to as the Demi-Sang trotteur, or those of the trotting type, and the Demi-Sang carrossier, or those of the coach type. There are now two studbooks in France for the registration of these : The French Studbook, A Register of Demi-Sang Horses Born and Imported in France, established in 1833; and the Studbook Trotteur, compiled and published in 1907. Records had been compiled before this, but only in recent years has the full importance of these become manifest to the patrons of the breed.

Speed records and races.

As to speed, M. W. Dunham, who has been an extensive importer and breeder, has compiled the following data from official records : In 1891, there were 1,399 contestants in races, 312 of which trotted races of two to three and three-fourths miles at less than three minutes per mile ; 137 under 2:50, 112 under 2:45 and 62 under 2:40. One hundred and one of the 312 were three-year-olds. The average distance was $2\frac{1}{16}$ miles ; average time per mile, 2:50 ; fastest time for three-year-olds, distance $2\frac{1}{2}$ miles, 6:33 ; fastest time for five- to seven-year-olds, distance $3\frac{1}{8}$ miles, 8 minutes. In further reference to speed it may be noted that in 1877, Zacinthe is credited with having trotted $18\frac{3}{4}$ miles over a good road in 59 minutes, and Niger in 1873 trotted $2\frac{1}{2}$ miles in 6:55. To prevent the sacrifice of size for speed, it is asserted by the authority just previously quoted that a law was enacted excluding all horses from public races that were under fifteen and one-fourth hands high.

As illustrating the conditions under which most of the races are held, the Derby of Rouen may be cited. It is worth 20,000 francs, made for three-year-olds, to be entered the year of their birth, and trotted in June on turf track two miles under saddle, fillies to carry 120 pounds, colts 125 pounds. From these conditions and the data submitted, it is easy to understand that the government's aim is to encourage speed at the trot without sacrificing stamina or substance.

Uses.

The use of the French coach horse for carriage, cavalry and fast saddle purposes will have been gathered from the preceding discussion. It remains to mention the use of French coach stallions on common mares bred in America for the production of a grade coach horse for general city purposes. Considerable success has followed such efforts when pure-bred stallions have been used. Half- and three-quarter-bred coachers have commanded high prices on the market.

Organizations and records.

The studbooks devoted to this breed in France are mentioned under *types*. The French Jockey Club, organized in 1833, has been responsible for much of the development of the breed. The French coach is represented in America by two societies, the French Coach Horse Society of America, organized in 1888, with the present secretary at Oak Park, Illinois, and the French Coach Horse Registry Company, organized in 1904, with headquarters in Columbus, Ohio. Each society published the first volume of its studbook in 1906.

Literature.

For references, see page 416.

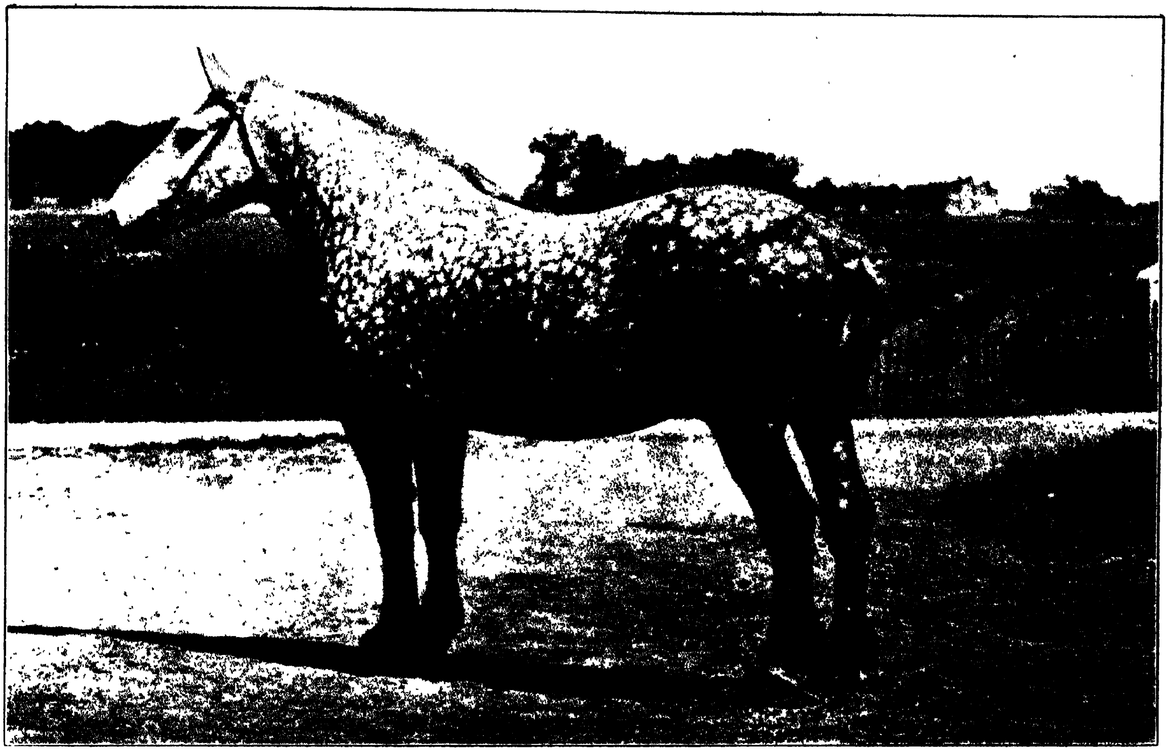
French Draft Horse. Figs. 467, 468.

By *W. L. Carlyle.*

A number of breeds and types of draft horses have been developed in France, and specimens of most of them have been introduced into America simply as French draft horses. This has led to some confusion in the names, as there is no single French draft breed, but rather several distinct breeds or types of French draft horses. The French draft horse best known in America is the Percheron (see pages 478–481). Others less well known are the Ardennais, Boulonnais, Breton and Nivernaise, which are here given brief treatment. The Picardy draft horse has been said to be a variety or type of the Boulonnais. By some writers it is held to be a Belgian breed.

Ardennais Horse.

This draft breed or type is a native of Ardennais, adjoining the Belgian frontier in northeastern France, and resembles very much in type and characteristics the Belgian draft horse. It is a very blocky, compact breed of great usefulness for producing heavy farm "chunks," and one type is used largely as heavy draft horses. Individuals of this breed scarcely equal in size the Belgians, but are of the same general type. The heads are strong, with small eyes and ears, short, thick necks, heavy shoulders and short, thick and compact bodies. The legs are short, of fairly good quality, although the feet are high and narrow. The color of the Ardennais is more frequently chestnut and roan than anything else, although bay and brown are sometimes found. Gray is not common and is not looked on with favor. When imported into this country, horses of this breed are eligible for registration in



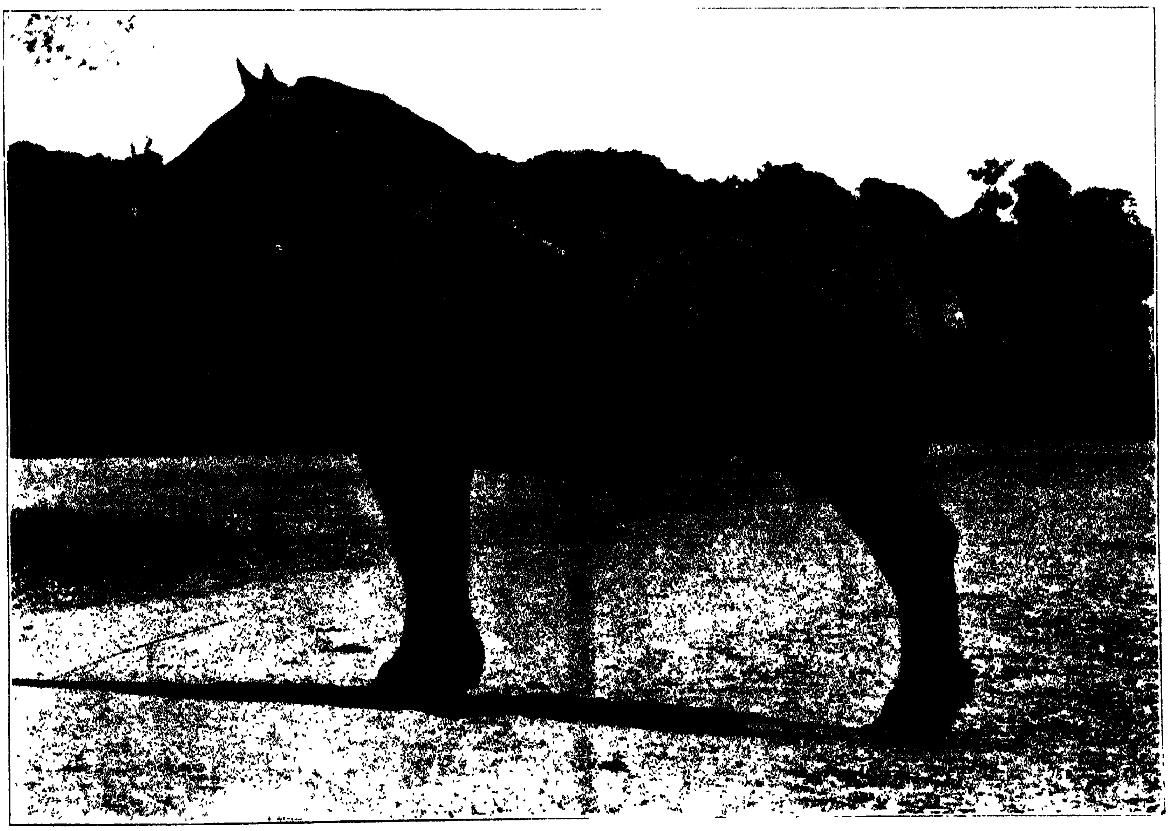


Plate XIV. Draft horses.—Percheron above, Belgian beneath

the studbook of the National French Draft Horse Association of America.

Boulonnais Horse. Fig. 467.

The head of the Boulonnais is of good size, being broad in the forehead and with a larger eye than the Percheron, and somewhat more clean-cut about

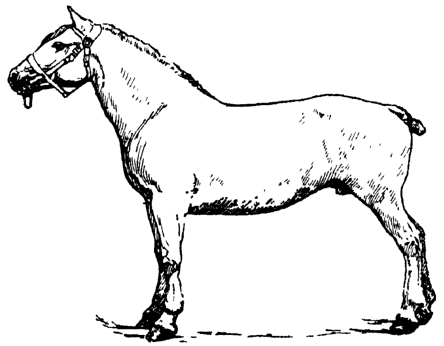


Fig. 467. Champion Boulonnais horse. Bigotte. (No. 2405.)

the lower part of the head. The neck is medium in length and clean-cut. The shoulders are laid well into the body and well muscled. The body is compact and deep-ribbed, with short and broad back and well-muscled loins. The croup and rump are inclined to be short and with a low-set tail. The hind-quarters are muscular and broad with well-filled thighs. The legs and feet are free from superfluous hair and are possessed of excellent quality. Many Americans favor the feet of the Boulonnais in preference to those of any of the other French breeds. On the whole, the feet are larger, more rounded and the pasterns have more slope than the Percherons. The colors are dapple gray, dark iron-gray, black, brown and occasionally chestnut.

The northern part of France has been particularly fertile in the production of high-class horses of various types. This has been due in part to the character of the soil and climate and to the character of food on which they have been fed, and in part also to the taste and temperament of the people in this section. In addition to the Percheron and *Demi-Sang Normand*, or French coach horse, there have been developed in this region several distinctive types or breeds ranging in characteristics from coach horses to the heaviest type of draft animals.

The Boulonnais breed originated in the Boulogne district in northeastern France adjoining Belgium. In common with the other draft breeds of France, the Boulonnais horses without doubt had their origin in the heavy Flemish horses. In their general characteristics they very much resemble the Percheron, so much so that it is impossible in the best specimens to distinguish one from the other. In recent years more animals of gray color are to be found among the Boulonnais than among the Percherons, and there has probably been less change and improvement in type in the Boulonnais breed than in the Percherons. They are not so large as the Percherons, and somewhat less refined, on the whole.

The breed has an excellent reputation in its native country, where an association has been formed and a studbook kept in the interest of the breed. It has been imported in large numbers to America and has more largely than any other breed made up what is known as the French draft breed.

This breed is growing in popularity in America, and its interests, together with other French draft breeds, are represented in the National French Draft Association of America, which publishes a studbook. This Association was first organized as the National Norman Horse Association in 1876, but its title was changed to the one that it now bears in 1885. The Association thus far has published nine studbooks. The present headquarters of the Association are at Denver, Colorado.

Breton Horse. Fig. 468.

This breed of light draft or general-purpose horses belongs to Brittany, in the western part of France in a section of country that is much broken in surface.

In general, these horses have intelligent heads, clean-cut necks of medium length, beautiful, round, well-muscled bodies with short backs and rather longer and straighter croups and rumps than the other French breeds, and with more quality in the legs and feet, the latter being large and more rounded in form than the Percheron or the Boulonnais. In color they are dapple-gray, with very few exceptions.

Brittany has been prominent in horse-breeding for many years, although the animals bred are rather of a miscellaneous type. The Breton horses are exceedingly useful and of much the same general character as the old-style Percherons, but are smaller and more refined in type. Many of the Percheron stallions

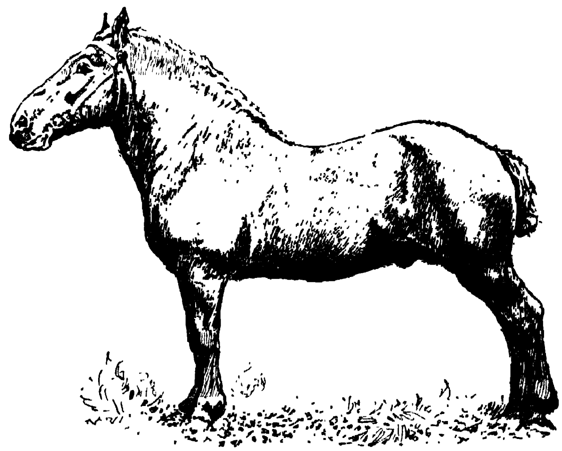


Fig. 468. A Breton Stallion.

have been taken into this district in recent years in an effort to improve the breed in size and character. It is stated by some historians that English races have been introduced into this section, which possibly accounts for the more luxuriant growth of hair about the legs. Representatives of this type of horses are used very largely in France as omni-

bus horses in the cities. They have not been imported to this country to any great extent, probably owing to their lack of size and weight.

This breed may be registered in the studbook of the National French Draft Horse Association of America.

Nivernaise Horse.

The Nivernaise is a breed of draft horses of French origin. The horses are of large size, with good length of neck, well-formed bodies of good length, massive shoulders and hind-quarters, very strong boned, giving the legs a rather round appearance. They are uniformly black in color. Seldom, if ever, is a gray, brown or chestnut to be found.

This breed of horses has been developed in the Department of Nivernaise, or Nièvre, in central France, and is one of the largest of the French draft horses. Its interests have not been very carefully looked after, and the choice specimens of the breed are not very numerous. It is only within the past two or three years that an association has been formed in France for the keeping of records in the form of a studbook. It is thought by Americans who have investigated the matter that the transformation in color and size in the Percheron horses in the past ten or fifteen years has been brought about, to some extent at least, by the use of the best types of Nivernaise stallions from this district, crossed on the mares of the LaPerche district.

This breed is being imported to America to an increasing extent in recent years, where it is classed as one of the French draft breeds. Individuals of this breed may be recorded in the studbook of the National French Draft Horse Association of America on the same basis as are the horses of the Boulonnais breed.

Literature.

For references, see page 416.

German Coach Horse. Fig. 469.

By *M. W. Harper.*

The name indicates that this is a breed of coach horses, taking its name from Germany, where it was developed. Horse-breeding in Germany is influenced greatly by military requirements, and there are found few of the powerful and compactly built types, such as the English Shire horse. Although Germany has several types or breeds of horses that are suitable for commercial and military purposes, she still imports many English horses.

Description.

In describing the characteristics of a typical German Coach horse as seen in America, the German Hanoverian and Oldenburg coach Horse Studbook says:

"The typical German horse is bay, brown or black, sixteen to sixteen and one-half hands high, and weighs 1,350 to 1,450 pounds. He has a deep, round body, close ribs, well proportioned, neck long and high set on the shoulders, neat at the throat, with neat head and with bright and intelligent countenance. His back is short and strong, smooth at coupling, tail well set, plump rounded quarters, strongly muscled limbs, strong hock, clean flat bone, and the best possible feet."

From the discussion of types given below, it will be evident that these horses vary in size. Coarseness is not uncommon, as seen in large head and joints, with more or less largeness of bone. In action, there is a wide difference of merit, and, from the coach horse point of view, they are frequently deficient in this respect. A superior folding of knee and flexing of hock, with desirable action, is not a prevailing attribute of the American specimens of the breed.

History.

The German Empire is composed of numerous states and principalities. Owing to the number of separate governments involved prior to the consolidation of the Empire, there was no single fixed policy followed, for which reason there are many marked differences between the various strains of coach horses found in the Empire. The multiplicity of states likewise renders it hard to reach very accurate conclusions regarding the early history of most of these strains, but there is no doubt that in point of antiquity these horses rank with any of the other breeds.

The northwestern parts of Germany, particularly the lowlands drained by the rivers Elbe, Weser and Ems, which flow into the North sea, has long been noted as the horse-breeding section of the Empire. Early records of horse-breeding in Germany go back nearly five centuries. As early as 1500, important annual fairs were held in Friesland, near the Holland boundary, where buyers from Holland, Belgium and Germany found superior horses. A government stud was established at Ilo, which contained 182 horses in 1648. At Harlingerland, in East Friesland, government studs were in operation, and reports refer to these as far back as 1712, when sixteen stallions were used for the service of 819 mares. In 1889, in this same region, fifteen stallions were used on 1,421 mares. It does not appear that the Germans have made extended use of the Thoroughbred in the evolution of some strains of their coach horses, although in others the trace of the blood is plainly discernible. It is well known that the German cavalryman with his kit weighs more than the soldier of any other army, hence we find the German horses possessing much substance. In other horse-breeding countries, we find draft and coach horses being developed side by side, which leads to a division of labor, the heavy or draft horses doing the heavy work, and the light horses doing the lighter work. This is not so in Germany, where the one breed serves both purposes. This leads to increased size. No effort to inject speed at the trot has been made at any time. The heavier soldiers, the heavier work and the slower gaits, all tend to increased size, hence we find the German coach the heaviest of the coach horses.

Government supervision of horse-breeding in Germany has obtained for centuries. The use of stallions on mares of East Friesland was regulated by royal edict for many years. It was made a law that no permits should be issued authorizing the use of stallions, unless the latter had passed a satisfactory government inspection. At the present time, both the government and the agricultural societies promote intelligent horse-breeding. Prizes are awarded to animals of special merit, and such animals must remain in the country for a specified term. First prizes are awarded only to mature horses and mares that have shown merit as breeders. Stallion shows have long been held at Aurich, in East Friesland, where the horses are brought annually for inspection and approval. Prizes for brood mares are also awarded by the government.

In America.—The history of the German coach horse in America is comparatively brief. It first made its appearance in the United States in the eighties. Not much prior to 1890 did the breed receive recognition at American shows. A. B. Holbert, of Greeley, Iowa, was one of the earliest introducers of the breed. Oltmann Brothers, of Illinois, and Crouch & Son, of Indiana, have also been most actively and prominently identified with its promotion in America.

German coach horses of importance are not as yet found in America in large numbers. Among the earlier ones imported, Moltke 13, Kaiser Wilhelm 494, Young Altma I 458, and Young Adonis 476, met with favorable comment, the latter being a successful prize-winner in California in 1891. In the central West, Bertus, brought out by Oltmann Brothers, and Ento and Hannibal, owned by Crouch & Son, have been distinguished in the show-ring, winning against the severest competition for years in succession.

Distribution.

The German coach horse is found in many countries throughout Europe, South Africa and both North and South America. In Canada, it is perhaps most popular in the Northwest. In the United States, it is most popular in the states of Indiana, Illinois and Iowa, but it is found in many parts of the country.

Types and families.

As stated above, owing to the conditions prevailing in Germany, we have many types of German coach horses. Perhaps the most noted are the East Prussian or Trakehner horses, the Hanoverian, the Holstein, the Oldenburg, the East Friesland, the Rhenish Prussian, the Mecklenburg and the Schleswig coach horses. Most of these strains have separate studbooks and are well recognized.

The East Prussian or Trakehner horse is perhaps the lightest of all. It has a good disposition, great endurance, a fine head, well-formed back and is well ribbed up. It is, perhaps, rather long legged, looks rather light for its height, and lacks the action that is admired in a carriage horse. The greatest horse-breeding center in East Prussia is the stud of Trakehner, which was founded in 1732 by Frederick William I, King of Prussia, and father of Frederick the Great. He furnished this stud with 1,101 horses from the royal studs. There were a few importations from Arabia and a few English Thoroughbreds added to the stud from time to time.

The Hanoverian horses are larger than the East Prussian horses. However, they are softer, and their action not so good, due, perhaps, to the Arabian and Thoroughbred blood in the East Prussian horses. They are used more for draft than for saddle purposes. They have strong legs and a good back, on which they can carry a load sufficiently heavy to make them serviceable military horses. These horses are bred by farmers, who work the brood mares on their farms. There is no trace of either Arabian or English Thoroughbred blood in their veins.

Fig. 469. German Coach stallion.

The Holstein horses are about equal to the Hanoverian in size. They are fine powerful horses, with good legs and free action, are suitable for both riding and driving, and are in great demand; but it is doubtful whether they are as enduring as the East Prussian horses. For many centuries, Holstein has been noted for its good horses.

Oldenburg horses are, perhaps, the parent of the German coach horses, and are used for heavy coach work, and for all-purpose horses, but seldom are used as saddlers. Some writers contend that these horses are not of the best quality, but stand in high favor because of their great size, some being seventeen hands high, and broad in proportion. They have good dispositions, and mature at an early age.

East Friesland horses are about as large as the Oldenburg horses, and have grown up under similar conditions. The East Friesland Studbook says: "The object of the breed is to produce a strong, noble and docile carriage horse, which will develop quickly, and can be put to light agricultural work in its third year, in order to refund a part of its cost of rearing."

Mecklenburg horses. — Although Mecklenburg horses were the finest saddle and coach horses in Germany eighty or ninety years ago, their breeding has been so badly managed, and English thoroughbred blood has been so indiscriminately introduced, that the best horses now in Mecklenburg are perhaps those of the Hanovarian or Holstein breeds, brought there to grow up under the favorable Mecklenburg conditions of soil and climate. Mecklenburg possesses high-lying pasture lands, which are admirably adapted for the breeding of good horses, and it is unfortunate that the breed declined.

Breeding, feeding and management.

In general, one would breed, feed and care for the German coach horse in the same way as for any other coach horse. However, in the breeding it is well to bear in mind that there are many strains of German coach horses, and that some of these strains differ very much in size, conformation, action and endurance. There is as much or more difference between the two extremes represented in these strains as there is between some of the distinct breeds, and it may be no more desirable to cross the light strains of German coach horses with the heavy strains than to cross some of the distinct breeds.

Uses.

As stated above, in the German Empire this is the horse-of-all-work. At home, this breed is called on to do the saddle work, the light as well as the heavy carriage work, and the draft work. In this country, the German coach horse differs from other coach horses in at least two respects. In the first place, there has never been any attempt to breed or train them to speed at the trot; and in the second place, some strains are decidedly heavier than the other coach horses, notably the Hackney and the French coach. There may be individual exceptions to this statement, but in this country the large German coacher ranks between the French coach and the Suffolk Punch, the lightest of the draft breeds.

Since we have the two extremes, varying so much in size, conformation and action, we might expect them to meet a variety of conditions. For example, take the East Prussian or Trakehner horses, which have some Arabian and Thoroughbred blood in their veins, and we would expect these to meet any condition requiring a light well-bred horse. They possess much quality, action and endurance, and are undoubtedly adapted for light coach work. On the other hand, take the heavy horses from Oldenburg, and we would not expect them to be so active nor so enduring. In fact, these big horses are looked on with disfavor by some persons. Count Wrangel says of them: "Most lovers of horses will acknowledge that their value, from a useful point of view, is not particularly great. The majority of Oldenburg horses which I have seen, have given me a very bad impression, and I would not use them for breeding at any price. As I may have been unfortunate in my acquaintance with them, I will merely say that their hereditary defects are heavy heads, weak backs, bad ribs, long legs, 'tied in' below the knee, brittle hoofs and want of endurance. These defects ought to prevent people from breeding such animals, because the fact that the horse is seventeen hands high and broad in proportion, has good manners and matures at an early age, is not sufficient to make a breeder ignore other and perhaps more important qualities." This criticism is perhaps too severe, but it comes from a German person of note.

Organizations and records.

The German, Hanoverian and Oldenburg Coach Horse Association of America was incorporated under the laws of the state of Illinois about 1892, and a studbook was started, containing pedigrees of registered stallions and mares imported, or raised in America. Two volumes have been issued to 1906. They contain the registration of about eighteen hundred animals, mostly stallions. Soon after the organization of the German, Hanoverian and Oldenburg Coach Horse Association, came the Oldenburg Coach Horse Association, which was also incorporated in Illinois. So far as the American public is aware, the various coach horses brought to America from Germany are known as the German coach breed, whether Oldenburg, Hanoverian, or otherwise. This difference of title may be accounted for in part by the variety of types. It would seem that the advocates of the breed would do well to clarify in some permanent way this apparent confusion of names.

Literature.

For references, see page 416.

Hackney Horse. Fig. 470.

By *John A. Craig.*

The present-day Hackney is a carriage horse breed. Among the early English writers on subjects relating to the horse, the word "hackney" was apparently used frequently as a synonym for roadster. The word ocurs in the earliest English, but its meaning, or rather the class of horse that it was applied to, is not made clear. Mr. Euren, the secretary of the English Hackney Horse Society, states that the Normans, at the time of their invasion, introduced the word *haquenée* or *hacquenée,* which he states was recognized as far back as the year 1303. Chaucer also used the word "hakeney" or "hacknay," but does not give any clue as to the class of horse referred to. Cully, an early English writer on livestock subjects, does not mention the Hackney. Lawrence, however, in some of his writings, gives us an inkling as to its application, and, as already stated, it meant a roadster.

Description.

The Hackney of true type is a horse of substance, extremely smooth and with gracefully curved outlines. Being full made, owing to splendid muscular development, and being on short legs, the representative of this breed suffers in stature in comparison with most of the other coach breeds. The type most sought, and the one that may be said to be the old-fashioned type, represents a powerfully

built horse, round-ribbed, muscular loin, and plump quarters, with short legs. The desire for more quality on the part of some of the breeders, and the use of Thoroughbred blood to secure it, had the effect of making some of them more bloodlike and rangier in appearance. The question of height in the Hackney has been liberally discussed, and the general belief is that a height of 15.2 to 16 hands is most compatible with the other features of the type that are most desired. It might be mentioned that until recent years the Hackney rings at the exhibitions of the Royal Agricultural Society of England were open only to horses not exceeding 15.2 hands in height. So many of the noted sires of later years have been over that height, that it was not advisable to enforce the restriction, and consequently it was removed. A well-known writer states that it is somewhat remarkable to note the circumstance that most of the successful stallions, both as sires and exhibition horses, of the present and past generations, have stood 15.2 hands high.

For a horse of such substance, the Hackney is not deficient in quality, although to combine the two in a right degree is as much a problem with the Hackney breeders as it is with the breeders of the other breeds of coach horses. Substance, meaning thereby muscular development and size of bone, is easily enough secured; but to have with it the refinement of features and tissues, with fluted legs, which makes up quality, is a combination of the highest excellencies.

Such being the general form, a more careful analysis of the several features that blend into the type desired is necessary to fill out the details of the true type. The Hackney head sometimes approaches meatiness, but, as a rule, it is well proportioned to the body, clean cut, with full eyes and specially alert and medium-sized ears. It has been criticised for a tendency towards being "bull" or thick-necked. There are some grounds for this criticism, but it is to be remembered that the heavy harness horse may be permitted to be fuller in the neck than those of more coachy type, in which length and slimness of neck contribute to high-headedness. In the Hackney, the shoulder is a point of particular importance, for it has a great deal to do with the high knee-folding action, so very much admired in the heavy harness horse. A long, sloping shoulder, well clothed with muscle, gives it that lifting power in front which is a feature of the front action more often met with in this breed than any other. The body must necessarily be deep and round-ribbed, to give that appearance of substance required, together with the rotundity characteristic of the type. A loin swathed in muscles, even to the extent of rounding upwards slightly, makes a strong, short coupling, which should join smoothly a plump rounded and deeply muscled hind-quarter. These, with muscular thighs and well-set and strong hocks, are derivative of the snappy and propelling hock action behind.

The action.—It is in the action of the Hackney that the chief merit of the breed resides for heavy-harness purposes, although this statement is not meant in the least to belittle the special type required also. It is stylish, attractive action, not speed, that is of most importance. The front feet, in walking or trotting, are lifted with snap and spring, and in the trot the foot goes forward after being uplifted, as if it were following the rim of a wheel. It is not held in the air at any one point; that is, the leg is not fully extended when the foot is several inches from the ground, but it is still following our imaginary rim of a wheel when it reaches the ground and is planted firmly. When

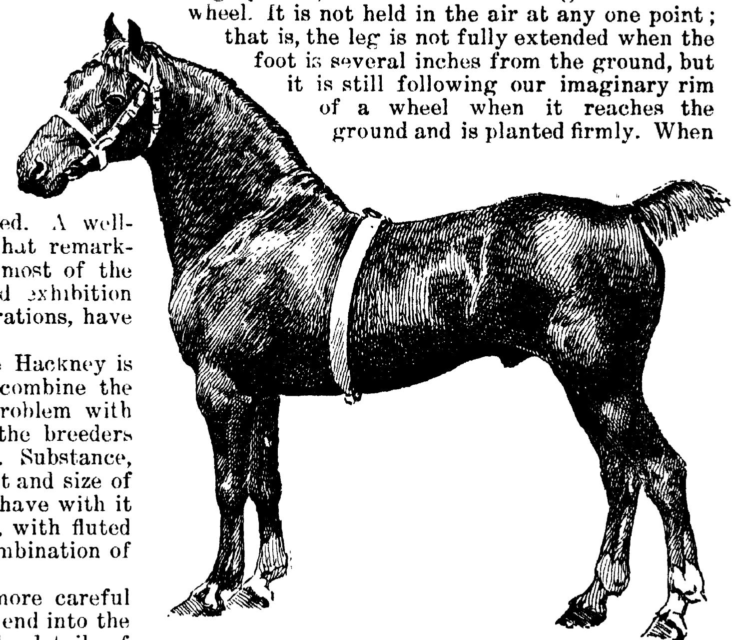


Fig. 470. **Hackney stallion.** Dilham Prime Minister, 13 hands, 3 inches high.

pulled up, it does not fly toward the elbows as if to hit them, but goes up and out without any delay in the knee-folding. While the fore action is a point of paramount importance, yet it may be said that in its hock action for heavy-harness purposes the Hackney has hardly a peer. The hock is lifted sharply toward the body, and the action is in no sense sprawling. Many horses can be made to step high and fold the knee, as a Hackney or heavy-harness horse should do, but the true heavy-harness hock action is not susceptible to artificial imitation. The weakness of most horses, other than Hackneys, in the heavy-harness classes, is that the hind-leg dwells somewhat like a duck swimming in water; it is not brought up quickly to the body. Very frequently, the leg from the hock down is thrown stiffly forward, making the horse spread or sprawl in his gait, as his hind-feet have to be thrown out and past the fore-feet. Such a horse, no matter how high or folding or even perfect his fore action may be, cannot go with that collected and well-balanced stride that a heavy-harness horse should have. He may likely go faster, but at a moderate gait, such as that which is most useful for heavy-harness horses, he cannot go collected and with snap and style. To

have snap and style in hind action is as necessary in the view of the critical horseman as that of the fore-feet, and, to have it, the hocks must be properly flexed, with perhaps less stifle action than that required for speed.

The color.—In reference to the color, it may be said that these horses are mostly brown, bay or chestnut, with some white markings. A rich, dappled brown is not an infrequent color. As they are mostly of solid colors, there is usually little difficulty in matching teams in this particular respect.

Soundness of the Hackney.—A note should be made of the fact that unsoundness is not frequent among Hackneys. While not in the least desiring to detract from this desirable trait, yet it needs to be qualified somewhat, especially when it is used to make invidious comparisons with the Standardbred trotter. The Standardbred trotter usually leads a strenuous life, beginning to race when two years old. The popularity of the colt trotter as a money-maker, because of the large stakes for two- and three-year-olds, as well as the large purses for free-for-all campaigners, puts our Standardbred trotter through a course of racing that is a very trying ordeal. The Hackney is more carefully kept and is never tried out in the sense that our trotting horses are, consequently it should be sounder and always fresher. The fact remains that the Hackney as a breed is unusually free from unsoundness. Since the Shire Horse Society of England wisely decided, in 1885, that all horses at their annual show should undergo veterinary examination conducted by three qualified veterinarians, other societies have followed the system, although with most of them only one veterinarian acts. In regard to the Hackney, it may be stated that the Hackney Horse Society for the past ten years has subjected the entries to its show to veterinary examination, and the percentage rejected has been very small. Of course, when such a system is in vogue, much carefulness on this point would be observed by exhibitors; consequently it is hardly a complete index to the prevalence of unsoundness in the breed as a whole. However, combined with general observation, the figures bear out the point that unsoundness is not very prevalent. In the years from 1896 to 1904, inclusive, 2,108 of the horses were examined, and 106 of these were rejected, showing an average of not quite 5 per cent rejected.

History.

The development of the Hackney into a breed may be traced to definite stimuli, which have been noticeable and in operation with more or less force in the development of several other breeds of horses. In the evolution of the breeds of light horses, there may be said to be a district suitable for rearing light horses of quality, which implies a soil well-drained, either light, hilly or underlaid with limestone, with good grass, all of which should indicate wholesome grazing conditions. With these associate men who love a horse, and let them be inspired with a definite aim, and the breed takes form and becomes popular according to the force and growth of the demand and ideals. A variety of sources are invariably drawn on, frequently very diverse in some attributes, but somewhat similar in the breed characteristics desired; and, these once secured, the aim becomes to concentrate and multiply them.

With these general conditions in view, let us bring their particular application to the Hackney. As bearing on this, and also to show that these factors were recognized by horsemen at a very early day, a quotation from Lawrence will suffice: "Light soils and a hilly surface of ground generally produce clean, vigorous and active horses, and probably there is no county in England where a better sort are bred than in Shropshire. Yorkshire and Lincolnshire are celebrated for carriage horses, and many very good ones are reared in those districts." Yorkshire and Norfolk were the original home of the Hackney, at an early time known also as the Norfolk trotter; and Yorkshire became prominent in the development of this breed, through the adaptability for light horses and superiority over the counties of Shropshire and Lincolnshire in this line, chiefly because of the other stimulus referred to—the Yorkshireman was an enthusiastic horseman. To carry the postulate to its full and more recent application, it is necessary only to direct attention to what Kentucky, Vermont, Virginia, Tennessee, and other states possessing the character of soil and people referred to, have accomplished. Conversely, apply what has been stated to be the evolution of draft breeds, and it will be apparent that the heaviest breeds of draft horses come from the lower and more level lands, with their more lush vegetation.

Continuing our reference to Yorkshire and Norfolk, it should be said that the demand during the earliest time was for a horse that could trot fast under saddle, and the horsemen of these two counties vigorously took up the work of breeding a stoutly built fast trotting horse of as much endurance as possible. It is said (Wallace, Live-Stock) that the Norwegian horse was used at a very early day on the common mares of these counties, as it was in Norfolk and Yorkshire, where the Norse invaders had their principal strongholds in England. The influence of this on the breed may be slighted when the more potent influence of the Thoroughbred is considered. It is also of interest to mention that even the blood of the Standardbred trotter found its way into some of the Hackney pedigrees through Shepherd F. Knapp, No. 282 in the register of Standardbred horses. The main source of the Hackney blood lines runs back to Arabian origin through the Thoroughbred, being similar in this respect to all the other breeds of light horses. Since the eighteenth century, the breed has been undergoing evolution, and it may be said to have had its inception with Shales (699), variously called "The Original," "Old Shales," etc. This horse, in the history of the Hackney or Norfolk trotter, stands in relation to the breed very much as Hambletonian 10 does in that of the Standardbred horse or American trotter; and, curiously enough, their breeding is of surprising similarity. Shales (699) was sired by Blaze, a Thoroughbred horse, foaled in 1733. It is said that

Blaze was not a Thoroughbred, but the best evidence we have credits him with being about as much so as any other horse of that early day. Blaze was by Flying Childers (a noted running horse), by the Darley Arabian. The dam of Blaze is asserted to have been by Grey Grantham, by Brownlow Turk out of a mare by the Duke of Rutland's Black Barb. Now the same Blaze sired Sampson, the sire of Engineer, he the sire of Mambrino, and he, in turn, the sire of Messenger, which was imported to America and was the grandsire of Hambletonian 10. Again, the dam of Hambletonian 10 was the Charles Kent mare by Imported Bellfounder, a Norfolk trotter tracing back through the Fireaways to Driver, a son of Shales by Blaze. The dam of the Kent mare was One Eye, by Bishop's Hambletonian, a son of Messenger. Yet again, Mambrino Chief was by Mambrino Paymaster, by Mambrino, by Messenger. So we have the two great lines of the American trotter, Hambletonian 10 and Mambrino Chief II, tracing back through Messenger to Blaze, and the most noted of the early sires of Hackneys or the Norfolk trotters going back to the same Blaze. May it not be reasonable to assume from these facts that from the latter horse has originated the trotting instinct, which has later developed into breed characteristics? Following the development of the Hackney, we find that Shales (699), considered the most famous trotter of his day in England, sired Driver (187) and Scott's Shales (692), and, according to the statement of a writer of authority, "to the former of these horses many—very many—of the best Hackneys of the day owe their origin." For example, Mr. Philip Triffitt's great sire, Fireaway, was by Achilles, by Achilles (Hairsines'), by Fireaway (Scott's), who was got by Fireaway (Ramsdale's), by Fireaway (Burgess'), by Fireaway (West's), by Fireaway (Jenkinson's), a son of Driver. It may be interesting to state here that John A. Logan is authority for the statement that the stock of Triffitt's Fireaway has sold to the amount of $2,500,000, which is somewhat of an index to the value of this horse to the breed.

Mention of other noted sires should include Denmark (177), sire of Danegelt; Lord Derby II (417), sire of Cadet, 1251; Confidence (158), sire of the Champion and Reality (665); and Rufus, an Elsenham Challenge cup winner and a noted progenitor of Hackney character.

With the change from use under the saddle to driving on the road attached to a vehicle, the Hackney's proclivities to trot do not seem to have undergone any change; although there was a tendency at this time toward refinement of the type, largely through the greater infusion of Thoroughbred blood. This also added to the height without changing the form much, except to add some to the straightness of the croup. Up to this time, and since, considerable evidence had been accumulating to indicate that the Hackney possessed more than ordinary excellence for long-distance trotting. Such records, it remains to be said, are of use only to enable us to understand the original characteristics of the breed, not for their official value to establish the reputation of the Hackney of the present day, for speed at the trot, for either long or short distances. It is to be remembered, also, that these records, if they may be called such, are in nearly all instances dependent on hearsay and not on official trials over measured distances. It is said that Driver (187), already referred to, trotted 17 miles within the hour, and Fireway is credited with having trotted 2 miles in 5 minutes. The performance that is most noteworthy is that credited to the mare Phenomena, that in July, 1800, trotted 17 miles in 56 minutes, and shortly afterward repeated the same performance in 53 minutes. Attention has been drawn to the fact that it was not until 1849 that Trustee, in America, trotted 20 miles in 59 minutes and 35½ seconds. The mare's rate would be 20 miles in 62⅓ minutes, showing that at that early day the Hackney or Norfolk trotter was noted for ability to trot long distances, with speed unusual at that time.

The secretary of the Hackney Horse Society, Mr. Euren, in the first volume of the studbook, credits the era of railroad building with dampening the ardor of the breeders of Hackneys; and, for a time, the breed did not receive much hearty support. A revival came in a very decided manner with the advent of exhibitions, and especially with the inauguration of horse-shows. Until the breed began to attract notice for heavy-harness and high-stepping purposes, they were not very largely imported from England, nor did they attain their present popularity in England. It was in the spring of 1893 that the first notable Hackney exhibition was held in England. In America, the horse-shows, the growth of recent years, as distinct from the usual live-stock shows, were factors that did more to popularize the Hackney than any other influences. The high-lifting action of the Hackney, both fore and aft, made a very attractive feature of the shows; and that, coupled with the growth of the high-stepping fad, gave the breed a strong impetus, although their genuine merit as heavy-harness horses has outlived this. The possession of stoutness of form with this action has adapted them particularly for heavy harness and heavy vehicles.

In America.—Aside from the first importation to America of Bellfounder (55), in 1822, by James Booth, of Boston, the next importation of note was the stallion Fordham, a son of Denmark, brought over in 1881, by Hillhurst Stock Farm, of which Senator Cochrane, of Quebec, Canada, was proprietor. Then comes the era of the horse-show, when extensive importations were made, chiefly into the New England states and Canada, with scattering importations into Ohio, Wisconsin and other states. The largest of these importations was made in 1890 by Mr. Seward Webb, of Vermont, who imported thirty-one horses, four of which were stallions. About this time, there was a lull in the profitableness of breeding Standard-bred trotters, which put many horses of this breeding on the market that otherwise would have been retained in the breeding stud. Attention was drawn to the fact that many horses of Standard-

bred trotting lines were competing with the Hackney, especially in the high-stepping classes, in the show-ring. They were more or less freaks, with the high stepping exaggerated by heavy shoeing and training, but they sometimes made a more popular show than the Hackney, by being able to go fast as well as high. There was little inclination among exhibitors at that time to stop and consider that fast going was not a much sought after characteristic for a high-stepping or a heavy-harness horse. A lessening of the interest in the mere high goer, and more attention to the trueness and serviceability of the action, has done good in recent years; and the outcome has been to strengthen the position of the Hackney and make it more decidedly a heavy-harness horse.

Distribution.

The good qualities of the Hackney have attracted world-wide attention, and, as a consequence, it is now found in many lands. In general, from England it has gone out into France, Germany, Holland, Denmark, Belgium, Spain, Italy, far east into Japan and south into Africa, Australia and New Zealand, and westward into the Argentine Republic in South America, and into Canada and the United States in North America. It is pressing its way into every land where heavy-harness horses are in demand. In America, the Hackney is bred in the largest numbers east of the Mississippi river, but numbers of the breed have become very broadly scattered over the states and provinces.

Uses.

From what has been written, it is clear that the special field for the Hackney is the production of heavy-harness horses, for the breed in itself has been specifically bred for that purpose. The high knee-folding action and attractive appearance, either standing or in motion, adapt it for the production of stylish heavy-harness horses for city driving. Possessing these qualities, with the substance and smoothness of type to wear heavy leather becomingly, the Hackney as a breed has superior claims.

The degree to which a breed may be useful in producing a marketable product is a factor that has to be considered, as well as the breed characteristics. However useful pure-bred horses may be, yet the degree to which they may contribute to the general improvement of the horses of a country is a broader and more influential factor entering into their standing. In this respect, the Hackney has established a reputation. On our common mares of much quality and some action, the Hackney makes a desirable cross. As Johnstone says, "the similarity of action I count the most salient of its features," and it is because this mechanical action is so deeply bred into the Hackney that it is, perhaps, the most likely of any of the European light horses to transmit it. It seems to be easier to produce the type than it is to secure the natural heavy-harness action. The tendency toward this action and type is surely stronger in the produce of the Hackney, because the breed itself has been bred for years for just those things; yet it is not safe to assume that it will come spontaneous to the surface without proper mannering and encouragement.

Organizations and records.

The societies devoted to the breed are the English Hackney Horse Society, established in 1883, with the first studbook published the following year, and the American Hackney Horse Society, with headquarters in New York City, established in 1891. The first volume of its studbook was published in 1893.

Literature.

For references, see page 416.

Hunter Horse. Fig. 471.

By *W. C. Bacon.*

The Hunter, as bred in America, cannot yet be called a breed of horses. The Irish Hunter, however, has been recognized as a distinct breed for a hundred years or more. The Hunter and the Standardbred trotter have come from the Thoroughbred, the Standardbred trotter having been developed in America as the result of the desire for a fast driving horse, and the Hunter breed developed in Ireland as the result of the demand for horses with Thoroughbred or ideal saddle conformation, that were able to carry much more weight than the pure-bred Thoroughbred. Ireland, therefore, may be said to be the home of the Hunter, or where this type of horses has been bred for so many years that it has long since been classed as a distinct breed, and recognized as such at all the fairs and horse shows in Great Britain.

Description.

The Hunter should not be high-headed, and the longer the rein the better. The fore-hand should be light. The withers should be higher than the croup, and the bones of the fore-limb comparatively long, so as to be able efficiently to raise the fore-hand both in taking and landing. The shoulders and pasterns should be long and sloping. The muscles that lie above the fore-arm should be well developed, as the fore-arm straightens the shoulder joint and the latter straightens the elbow joint, two actions which help to prevent the horse falling when he lands over a jump. The muscles over the loins behind the saddle should be particularly strong. The hocks should be large and gaskins broad.

The following is a detailed description of the points of an ideal Hunter: *Head.*—Ears fine, not too large, approaching each other at the tips, when thrown forward; cranium broad and nicely rounded; forehead flat and broad; eyes wide apart, prominent and bold in expression; nasal bones straight in front, but slightly dished on lateral surfaces; nostrils firm, large and flexible, of large capacity when the animal is excited; lips firm, mouth medium-sized; muzzle small and tapering; cheeks well but not too heavily clothed with

Plate XV. Hackneys above (four years old); gaited saddler below

hard, well-developed muscles; branches of lower jaw well spread apart at their angles. *Neck.*—Clean-cut and rangy; crest well developed and whipcordy, but not so heavy as in other classes; head well attached to neck in a graceful, angular manner; jugular gutter well developed. *Withers.*—Well developed, high, and not too wide on top. The withers should be sloping and of such form that the saddle may be placed well back over the center of gravity, which is especially desirable in negotiating timber. *Shoulders.*—Long and oblique, so as to give easy action; shoulder-blades well covered with muscles. *Chest.*—Deep, giving good girths, with a well-filled breast. *Arm.*—Thrown well forward, so as to give an oblique shoulder. *Forearm.*—Long, well developed, and strong, well clothed with hard, well-developed muscles, having grooves of demarcation between them, showing the outlines of each individual muscle. *Knee.*—Clean, straight, large and strong in all directions, the bone forming the back part being somewhat prominent. *Knee to fetlock joint.*—Cannon short, broad, flat, and clean; tendons standing out plainly, hard and whipcordy. The lines of demarcation between tendon and ligament, and between ligament and bone must be well supported beneath the knee, not showing any tendency to weakness. *Fetlocks.*—Strong and well supported. *Front pastern.* Strong, medium length and oblique. *Front feet.*—Rather smaller in proportion than in other breeds, round, strong, and fairly deep wall; soles concave, frog well developed; heels full and not too deep; toes turning neither in nor out while standing. *Body.*—Back strong and inclined to be short, with a long under-line; loin broad and well muscled; ribs well sprung and of good depth. The under-line must be long, otherwise the horse will be shortened in his gait. To get this long under-line, perhaps a longer back will be required than would otherwise be desirable. *Croup.*—Well muscled, carried out straight to tail, which should be full haired and very stylishly carried. *Hock.*—Deep and strong in all directions; all points well developed, but not rough; absence of malformations or puffiness; point very well developed, straight on posterior border; the whole joint clean, hard, and of an angular shape. *Hock to fetlock.*—Cannon short, wider and flatter than in front; tendons well marked individually, and must not have a pinched appearance below joint in front, but very gradually taper in width from hock to fetlock. *Fetlock joint.*—Large, clean-cut and strong. *Hind pasterns.*—Medium length, sloping and strong. *Hind-feet.*—Smaller and not so round as the front ones; sole more concave; frog well developed; heel good width and not too deep. *Color.*—Bay, brown or chestnut, black, roan and gray; with reasonable modifications. *Skin and hair.*—Skin soft, mellow, and loose, hair fine, silky, and straight and soft in comparison with other breeds. *Temperament.*—Mild, energetic, not vicious nor too nervous. *Action.*—Prompt, free, and elastic, not too much knee and hock action, but going close to the ground, especially in the canter and gallop; no paddle or roll, and front feet not to go close enough behind to interfere; a good straightaway walker. *Weight.*—1,000 to 1,300 pounds *Height.*—15 hands 1 inch to 16 hands and over.

Breeding in America.

The breeding of Hunters in America has hardly progressed far enough in any one section of the

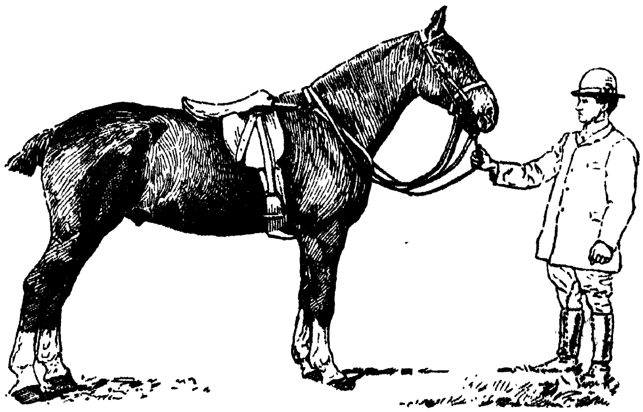


Fig. 471. The Hunter, "Guardsman." Owned by John Clay.

country to distinguish such animals as "pure bred." However, a great many animals are yearly bred in this country for the special purpose of producing Hunters. The method of breeding is the same as originally adopted in Ireland, namely, the use of Thoroughbred stallions on native or grade mares. As the external conformation usually follows the sire, the breeders of Hunters are usually able to produce, even in the first cross, saddle conformation, and at the same time to have transmitted to such a cross sufficient of the courage, intelligence and staying qualities of the Thoroughbred to make the first cross (half-blood) a most satisfactory animal for cross-country riding to hounds. The fact that those half-, three-quarter- and seven-eighth-blood horses make such satisfactory Hunters is probably the reason why, in this country, there has been no general movement in any one section to continue special breeding. However, a great many clean-bred horses are favored by many persons for cross-country work. This special line of breeding has not been followed long enough for the breed to become fixed. In fact, the demand for such horses has always exceeded the supply in America to such an extent that the type has never had an opportunity to become thoroughly established. Nevertheless, there has been a National Steeple Chase and Hunt Association organized in America under the auspices of The Jockey Club, that admits to register almost any animal with one or more crosses of Thoroughbred blood, that has been regularly "hunted" a certain number of times, with some recognized pack of hounds, and approved by the master.

Hunter-breeding in America is conducted to a limited extent in the neighborhood of most of the

organized hunt clubs, of which there are some fifty in the eastern states. In such sections one will find one to half a dozen Thoroughbred stallions in general use among the farmers of that special community. In the Genesee valley in Livingston county, New York, for example, there are no less than eight Thoroughbred stallions within a radius of fifteen miles, being used on the farm mares of the neighborhood for the special purpose of breeding Hunters. Virginia probably produces more animals that are especially bred for hunting than any other state. Of late years, however, the Jockey Club has put out many Thoroughbred stallions throughout the state of New York, which in a few years should make that state prominent for breeding Hunters. Hitherto, Canada has been one of the principal sources from which American hunting men have been supplied. The Canadian Hunters come largely from between Toronto and London, Ont., where Thoroughbred stallions have been very generally used.

Distribution.

As hunting has long occupied a place in the sports of nations, horses that may be characterized as hunters are widely distributed. From Ireland, the home of the breed, the Hunter has been scattered over great Britain and the continent. In 1904, the Dutch government bought 350 young mares of this breed in Ireland. In America, both Canada and the United States are devoting increasing attention to the production of horses for hunting purposes.

Classes.

At the leading horse shows there are several classes for Hunters of different types and different weight-carrying abilities. *Qualified* Hunters are those that have been registered with the National Steeple Chase and Hunt Association, but need not be clean bred. *Heavy-weight* Hunters must carry up to 200 pounds to hounds (qualified and not qualified). *Middle-weight* Hunters must carry up to 180 pounds to hounds (qualified and not qualified). *Light-weight* Hunters must carry up to 165 pounds to hounds (qualified and not qualified). *Thoroughbred* Hunters must be registered in the studbook.

Feeding and care.

The Hunter should not have more than three or four days of all-day fox-hunting in a fortnight; with drags, some may go three times a week, but much depends on the going and the length of the runs. The Hunter should be jogged home after the hunt, given warm gruel and thoroughly rubbed. A groom should exercise him gently on non-hunting days for about five miles early in the morning. He should be carefully looked after and given the best of oats and hay. The night before he is to be "hunted," water should be kept in his stall all night, so that he may take it at will. He should be fed very early and saddled only just before he is ordered.

Organizations and records.

In Great Britain, the interests of the breed are in the hands of the Hunter Improvement Society of Great Britain. Two volumes of the Hunter Studbook have been published and a third is in preparation. The pedigree qualifications of the Hunter Studbook are that the stallions shall be by a Thoroughbred or registered Hunter sire out of a fully registered mare, and the mares shall show two crosses of Thoroughbred or registered Hunter blood, viz, sire and dam's sire, or if dams of winners of races under rules, and accepted after inspection. The supplement of the studbook is open to mares (1) by a Thoroughbred or registered Hunter sire, winners or dams of winners of prizes or medals at national, county or associated shows, or (2) by inspection and veterinary examination. In America, The Jockey Club with headquarters in New York City, was instrumental in the organization of the National Steeple Chase and Hunt Association, which registers and otherwise looks after the development of the Hunter and the steeple-chaser, discussed in the following paragraph.

STEEPLE-CHASERS.

The steeple-chaser is almost always a clean-bred horse, that has natural or made adaptability to jump. He must be more seasoned than the Thoroughbred that is to run on the flat, and must be up to a good deal more weight. There are certain blood lines that have produced natural jumpers, which, when "nicked" with certain mares, have produced fencers. Many horses that, perhaps, have not enough speed for the flat, have been schooled and made good chasers. Unlike the steady fox-hunting Hunter, the steeple-chaser must be able to go a good pace and take his fences flying, or almost as fast as in a hurdle race. In this type of horse, the adaptability for the special performance and the result gives the horse his place and name as a steeple-chaser.

Literature.

The literature of the Hunter is for the most part interwoven with expositions of the chase, and is not specific and direct. Yet some direct discussions will be found in the works referred to on page 416. Other references are: Peer, Cross Country with Horse and Hound; Walsh, The Horse in the Stable and in the Field, Loudon (1871); Goodwin, The Turf Guides; Nimrod, The Chase, the Road and the Turf; White, The History of the British Turf, two volumes, Loudon (1840); Curzon, A Mirror of the Turf, Loudon (1892).

Military Horse. Figs. 472, 473.

For military purposes, several distinct types of horses are required according to the use to which they are to be put; and each type must conform carefully to a standard set by the War Department. The specifications for each type issued by the War Departments of the United States and Great Britain (for Canada) are inserted in this Cyclopedia for their reference value, and also that farmers interested in breeding horses for army use may be informed as to what is required.

Horse Types Required by the United States War Department

All of the specifications that follow were prepared under the direction of the Quartermaster General. Those for medium and light draft horses and for cavalry horses, were issued under date of November 25, 1903; for saddle horses for mountain batteries, August 3, 1907; for artillery horses, October 15, 1906; for small horses for orderlies and mounted messengers, January 17, 1908; for mules, November 5, 1907.

Specifications for cavalry horses.

The cavalry horse must be sound, well bred, of a superior class, and have quality; gentle and of a kind disposition; thoroughly broken to the saddle, with light and elastic mouth, easy gaits, and free and prompt action at the walk, trot, and gallop; free from vicious habits, without material blemish or defect; and otherwise to conform to the following description:

A gelding of uniform and hardy color, in good condition; from four to eight years old; weighing from 950 to 1,100 pounds, depending on height, which should be from 15 to 15¾ hands.

Head.—Small and well set on neck; with ears small, thin, neat, and erect; forehead broad and full; eyes large, prominent, and mild, with well-developed brow and fine eyelid; vision perfect in every respect; muzzle small and fine; mouth deep; lips thin and firmly compressed; nostrils large and fine; and branches of under-jaw (adjoining neck) wide apart.

Neck.—Light, moderately long, and tapering toward the head, with crest firm and longer than underside; mane fine and intact.

Withers.—Elevated, not unduly fine, well developed and muscled.

Shoulders.—Long, oblique, and well muscled.

Chest.—Full, very deep, moderately broad, and plump in front.

Fore-legs.—Vertical, and properly placed; with elbow large, long, prominent, and clear of chest; fore-arm large at the elbow, long and heavily muscled.

Knees.—Neatly outlined, large, prominent, wide in front, well situated, and well directed.

Back.—Short, straight, and well muscled.

Loins.—Broad, straight, very short and muscular.

Barrel.—Large, increasing in size toward flanks, with ribs well arched and definitely separated.

Hind-quarters.—Wide, thick, very long, full, heavily muscled, rounded externally; and well directed.

Tail.—Fine and intact; well carried and firm.

Hocks.—Neatly outlined, lean, large, wide from front to rear, well situated, and well directed.

Limbs.—From knees and hocks downward, vertical, short, wide laterally, with tendons and ligaments standing well out from bone and distinctly defined.

Pasterns.—Strong, medium length, not too oblique, and well directed.

Feet.—Medium size, circular in shape, sound; with horn dark, smooth, and of fine texture; sole moderately concave, and frog well developed, sound, firm large, elastic and healthy.

Each horse will be subjected to a rigid inspection, and any animal that does not meet the above requirements should be rejected. No white or gray horses to be accepted.

Specifications for saddle horses for mountain batteries.

The specifications are the same as for cavalry horses, except that the weight must be 950 to 1,070 pounds, depending on height, which should be 15 to 15½ hands.

Specifications for small horses for orderlies and mounted messengers.

The small horse for orderlies and mounted messengers must be sound, well bred, of a superior class, and have quality; gentle and of a kind disposition; well broken to the saddle, with light and elastic mouth, easy gaits, and free and prompt action at the walk, trot and gallop; free from vicious habits, without material blemish or defect; handy, speedy and suitable in all other respects, and otherwise to conform to the following description:

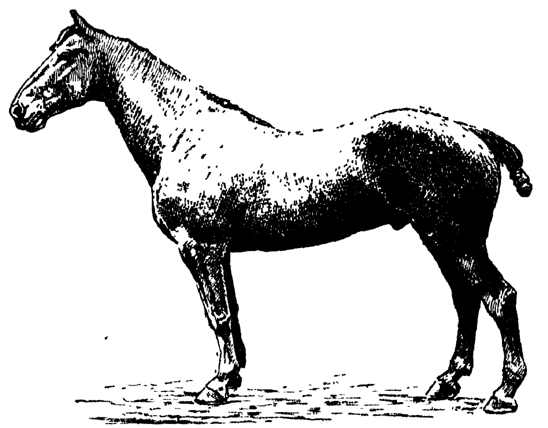


Fig. 472. General. a brown gelding. Winner of first prize as cavalry horse type, Canadian Horse Show.

A gelding of uniform and hardy color, in good condition; from 4 to 8 years old; weighing from 825 to 950 pounds, depending on height, which should be from 14½ to 15 hands.

The remainder of the description is the same as that given above for cavalry horses.

Specifications for artillery horses for siege batteries.

The artillery horse for siege batteries must be sound, well bred, of a superior class, and have quality; of a kind disposition, well broken to harness, and gentle under the saddle, with easy mouth and gaits, and free and prompt action at the walk, trot and gallop; free from vicious habits; without material blemish or defect, and otherwise to conform with the following description:

A gelding or mare of hardy color, in good con-

dition, from 4 to 8 years old ; height, from 16 to 17 hands; weight, from 1,350 to 1,650 pounds. Horses otherwise satisfactory, which fall short of or exceed these limits of weight by not more than 50 pounds, due to temporary conditions, may be accepted. Mares in foal will not be accepted.

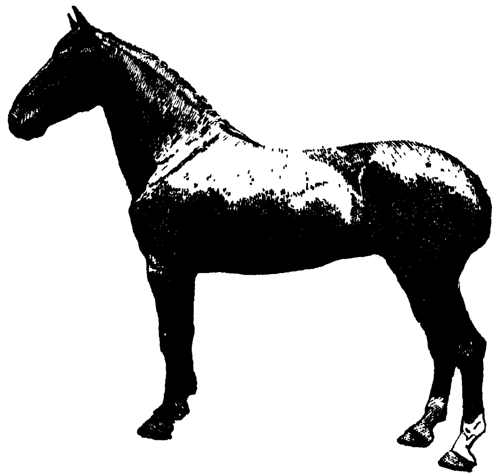


Fig. 473. Cassandra, a pure-bred Hackney mare. Winner of first prize as artillery horse type, Canadian Horse Show, Toronto, April, 1900. This mare represents the lighter type desired, weighing 1,325 pounds.

Head.— Small and well set on neck ; with ears small, thin, neat, and erect ; forehead broad and full ; eyes large, prominent and mild, with well-developed brow and fine eyelid ; vision perfect in every respect ; muzzle small and fine ; mouth deep ; lips thin and firmly compressed ; nostrils large and fine, and branches of under jaw (adjoining neck) wide apart.

Neck.—Moderately long and tapering toward the head, with crest firm and longer than under side ; mane fine and intact.

Withers.—Elevated, not unduly fine, well developed and muscled.

Shoulders.— Long, oblique, well packed with muscle, not too heavy, smooth, rounded, and so formed as properly to support the collar.

Chest.— High, wide, very deep ; plump in front and full.

Fore-legs.—Vertical and properly placed ; with elbow large, long, prominent, clear of chest, and well placed ; fore-arm wide, thick, long, heavily muscled and vertical.

Knees.— Neatly outlined, large, prominent, wide in front, well situated and well directed.

Back.—Short, straight and well muscled.

Loins.—Broad, straight, very short and muscular.

Barrel.—Large, increasing in size toward flanks, with ribs well arched and definitely separated.

Hind-quarters.— Wide, thick, very long, full, heavily muscled, rounded externally and well directed.

Tail.—Fine and intact ; well carried and firm.

Hocks.—Neatly outlined, lean, large, wide from front to rear, and well directed.

Limbs.—From knees and hocks downward, vertical, short, wide laterally, with tendons and ligaments standing well out from bone and distinctly defined.

Pasterns.— Strong, medium length, not too oblique, and well directed.

Feet.—Medium size, circular in shape, sound ; with horn dark, smooth, and of fine texture ; sole moderately concave, and frog well developed, sound, firm, large, elastic and healthy.

Each horse will be subjected to a rigid inspection, and any animal that does not meet the above requirements should be rejected.

Long-legged, loose-jointed, long-bodied, narrow-chested, coarse and cold-blooded horses, as well as those which are restive, vicious, or too free in harness, or which do not, upon rigid inspection, meet the above requirements in every respect, will be rejected. A horse under five years old should not be accepted, unless a specially fine, well-developed animal. No white or gray horses will be accepted.

Specifications for artillery horses for light and horse batteries.

These specifications are the same as those for the artillery horses for siege batteries, except that the height should be 15½ to 16 hands, and the weight, 1,150 to 1,250 pounds. The artillery horse for light and horse batteries is required for quick draft purposes, and should be heavy enough to move the carriage, ordinarily, by weight thrown into the collar, rather than by muscular exertion.

Specifications for light draft (coach) horses.

The light draft horse must be sound, well bred, of a superior class, and have quality ; of a kind disposition ; thoroughly broken to harness ; with easy mouth, and free, prompt, straight, and true action at the walk and trot ; free from vicious habits ; without material blemish or defect ; and otherwise conform to the following description :

A gelding of uniform and hardy color, in good condition ; from five to seven years old ; weighing from 1,100 to 1,200 pounds, depending on height, which should be from 15½ to 16 hands.

Head.—Small, and well set on neck ; with ears small, thin, neat, and erect ; forehead broad and full ; eyes large, prominent, and mild, with well-developed brow and fine eyelid ; vision perfect in every respect ; muzzle small and fine ; mouth deep ; lips thin and firmly compressed ; nostrils large and fine ; and branches of under-jaw (adjoining neck) wide apart.

Neck.— Light, moderately long, and tapering toward the head, with crest firm and longer than underside ; mane fine and intact.

Withers.—Elevated, not unduly fine, well developed and muscled.

Shoulders.— Long, oblique, well packed with muscle, not too heavy, smooth, rounded, and so formed as properly to support the collar.

Chest.—High, wide, very deep, plump in front and full.

Fore-legs.—Vertical, and properly placed ; with elbow large, long, prominent, clear of chest, and

well placed; fore-arm wide, thick, long, heavily muscled, and vertical.

Knees.—Fine, thick, and wide in front, prominent, well situated, well directed, and free from blemishes.

Back.—Short, straight, and well muscled.

Loins.—Broad, straight, very short and muscular.

Barrel.—Large, with ribs definitely separated from each other, and well-arched from girth toward flank.

Hind-quarters.—Wide, thick, very long, full, heavily muscled, rounded externally, and well directed.

Tail.—Fine and intact, well carried and firm.

Hocks.—Neatly outlined, lean, large, wide from front to rear, and well directed.

Limbs.—From knees and hocks downward vertical, short, wide laterally, with tendons and ligaments standing well out from bone, and distinctly defined.

Pasterns.—Strong, medium length, not too oblique, and well directed.

Feet.—Medium size, circular in shape, and sound; with horn dark, smooth, and of fine texture; sole moderately concave, and frog well developed, sound, firm, large, elastic, and healthy in appearance.

Each horse will be subjected to a rigid inspection, and any animal that does not meet the above requirements should be rejected.

Specifications for medium draft horses.

The medium draft horse must be sound, well bred, and of a superior class; gentle and of a kind disposition; thoroughly broken to harness, with easy mouth and free, prompt, straight, and regular action at the walk and trot; free from vicious habits, without material blemish or defect, and otherwise to conform to the following description:

A gelding of uniform and hardy color, in good condition; from 5 to 7 years old; weighing from 1,200 to 1,400 pounds, depending on height, which should be from 15½ to 16 hands.

Head.—Small and well set on neck; with ears small, thin and erect; forehead broad and full; eyes large, prominent and mild, with well-developed brow and fine eyelid; vision perfect in every respect; muzzle fine; mouth deep; lips thin and firmly compressed; nostrils large and fine, and branches of under jaw wide apart adjoining neck.

Neck.—Moderately long and tapering toward the head, with crest firm and longer than underside; mane fine and intact.

Withers.—Elevated, not unduly fine, well developed and muscled.

Shoulders.—Long, oblique, well muscled, smooth, rounded and so formed as properly to support the collar.

Chest.—Full, high, wide, deep, and plump in front.

Fore-legs.—Vertical, and properly placed; with elbow large, long, prominent, clear of chest, and well placed; fore-arm wide, thick, long, heavily muscled and vertical.

Knees.—Fine, thick, and wide in front, prominent, well situated, well directed, and free from blemishes.

Back.—Short, straight, well muscled, and strongly coupled to hind-quarters.

Loins.—Broad, straight, very short and muscular.

Barrel.—Large, with ribs definitely separated from each other and well arched.

Hind-quarters.—Wide, thick, very long, full, heavily muscled, rounded externally and well directed.

Tail.—Fine and intact; well carried and firm.

Hocks.—Neatly outlined, lean, large, wide from front to rear and well directed.

Limbs.—From knees and hocks downward, vertical, very short, wide laterally, with tendons and ligaments standing well out from bone, and distinctly defined.

Pasterns.—Strong, medium length, not too oblique, and well directed.

Feet.—Medium size, circular in shape, and sound; with horn dark, smooth, and of fine texture, sole moderately concave, and frog well developed, sound, firm, large, elastic and healthy in appearance.

Each horse will be subjected to a rigid inspection, and any animal that does not meet with the above requirements, should be rejected.

Specifications for mules.

The mule must be sound, well bred, and of a superior class; of a kind disposition, gentle, and well broken to harness, with the exception of the pack mule; with free and prompt action at the walk or trot; free from vicious habits, without material blemish or defect, and otherwise to conform to the following description:

A gelding or mare of uniform and hardy color, in good condition; from four to eight years old; weight, depending on height, to be as follows:

Wheel mules for six-mule teams, to weigh from 1,150 to 1,200 pounds, and be from 15 hands 3 inches to 16 hands high.

Swing mules for six-mule team, to weigh 1,050 to 1,150 pounds, and be from 15 hands 1 inch to 15 hands 3 inches high.

Lead mules for six-mule team, to weigh from 950 to 1,050 pounds, and be from 14 hands 3 inches to 15 hands 1 inch high.

Wheel mules for four-mule team, to weigh from 1,100 to 1,200 pounds, and be from 15 hands 2 inches to 16 hands high.

Lead mules for four-mule team, to weigh from 1,050 to 1,100 pounds, and be from 15 hands 1 inch to 15 hands 2 inches high.

Riding mules for wagons and pack trains, to weigh from 1,000 to 1,050 pounds, and be from 15 hands to 15 hands 1 inch high, broken to saddle.

Saddle mules for mountain batteries to be broken to saddle, to weigh from 950 to 1,000 pounds, and be from 14 hands 2 inches to 15 hands high.

Pack mules to weigh from 850 to 1,000 pounds, and be from 13 hands 3 inches to 15 hands high.

Pack mules for mountain batteries and for machine gun platoons, to weigh from 950 to 1,000 pounds, and be from 14 hands 2 inches to 15 hands high.

Head.—Fine and of medium size, with ears fine

and erect; forehead broad and full; eyes large, clear, prominent, and mild, with well-developed brow and fine eyelid; vision perfect in every respect, nostrils large and open.

Neck.—Medium length and smoothly joined to the shoulder and withers, with crest firm and full.

Shoulders. — Long, oblique, well and smoothly muscled, and so formed as to provide proper support for the collar.

Chest.—High, wide, very deep, and full.

Back.—Short, straight, and well and smoothly muscled.

Loins.—Broad, straight, very short and muscular.

Barrel.—Large, with ribs well arched and definitely separated from each other.

Fore-legs.—Vertical and properly placed; with elbow large, long and clear of chest; fore-arms large, very long, heavily muscled and vertical.

Knees.—Large, wide in front, well placed, and free from blemishes.

Hind-quarters.—Wide, thick, very long, full, heavily muscled, rounded externally, and well directed.

Hocks.—Neatly outlined, lean, large, wide from front to rear, and well directed.

Limbs.—From knees and hocks downward, vertical, short, wide laterally, with tendons and ligaments standing well out from bone, and distinctly defined.

Pasterns. — Strong, medium length, not too oblique, and well directed.

Feet.—Medium size and sound; with horn dark, smooth, and of fine texture; frog well developed, elastic and healthy.

Each mule will be subjected to a rigid inspection, and any animal that does not meet the above requirements should be rejected.

Horses Required by the British War Office

The following specifications, issued by the British War Office, designate the types of army horses called for in Canada. A discussion of the breeding of horses in Canada for army use will be found in Appendix I of "The Horse," by Roberts.

The classes and types of horses required for the army may be generally described as follows: (1) *Chargers* (for officers).—Height from 15 hands 1 inch to 15 hands 3 inches. (2) *Riding horses* (troopers).—Height from 15 hands 1 inch to 15 hands 2½ inches. (3) *Cobs* (for mounted infantry).—Height from 14 hands 2 inches to 15 hands. (4) *Draft horses* (for gun and wagon).—Height from 15 hands 2 inches to 15 hands 3½ inches.

Age.—From 4 years (off) to 6 years.

Color.—Bays, browns and blacks preferred, but chestnuts will be accepted. Whites, grays, piebalds or skewbalds, etc., are required only for special purposes. Light, washy-colored horses are not accepted.

Sex.—Geldings or mares. Entire or unmanageable horses are not accepted.

Unhogged manes and *undocked tails* are desired, especially in the case of chargers. Good horses with short manes and docks can be accepted.

Soundness.—No horse is accepted without passing a veterinary examination; and soundness in wind, eyes and limb is insisted on. Stale, upright and over-shooting joints, weak or curby hocks, brushing, dishing, or untrue action, turned-in or turned-out toes and weak feet are absolute disqualifications.

Chargers, riding horses and *cobs* should be short-legged, short-backed, good-barrelled, with good rein and shoulders, of the hunter stamp, with substance and quality, action true and quite clear of the joints.

Draft horses should not be too big, but fit to carry a man driving postillion; active and able to gallop, deep, short-legged, well ribbed-up, with plenty of substance and quality; action true and quite clear of the joints. Very coarse horses and those with heavy rolling action are not accepted.

Note.—No horses will be purchased unless they have been handled and are reasonably quiet.

Orloff Trotting Horse. Figs. 474, 475.

By *C. S. Plumb.*

The Orloff trotter, as its name implies, is a breed of trotting horses used chiefly for driving purposes.

Description.

This Russian breed of horses does not possess very great uniformity. A well-accepted height is sixteen hands, with a weight of 1,100 to 1,300 pounds. The color is variable, gray, white or black being most common, with chestnut and bay not infrequent. Quality is not a notable feature. The head is frequently small and neat, of Arabian character, with some dish to the face. The neck is inclined to be strong and a bit throaty, and in good specimens is well arched and carried high. The withers stand high, the back is short and strong and the loin full and muscular. The croup has a sloping tendency and is commonly criticized in this respect, but is powerfully muscled. The shoulders are rather sloping, and while strong and active in character, lack heaviness of form. The legs are strongly muscled, the tendons stand out well, while the bone and feet are regarded as of very superior quality. Russians lay much emphasis on the soundness of limb and endurance of this breed. In its native home, the Orloff has a rather heavy coat of hair and a thick forelock, mane and tail. This heaviness of hair gives something of a rough appearance, which may sometimes give an unfair impression of the horse.

History.

The early history of the Orloff trotter seems to be very well established, excepting for minor details. Count Alexis Orloff, of Russia, in 1777, it is said, began the work of developing a new breed of horses that would be better than any existing Russian breed. Some authorities state that he secured an Arab stallion from the Sultan of Turkey in 1780, while others state that this same stallion, Smetanka, was purchased by Orloff, in southern Greece, in 1777, for 60,000 roubles ($8,570). This was a very pure Arab, of a silvery white color, very strong and muscular and about fifteen hands

high. Smetanka was used in Orloff's stud but one year, when he died, but he sired four stallions and one mare, all but one from English Thoroughbred mares. One son, Polkan, known as Polkan 1st, was from a "big, long, Isabel Danish mare." Polkan was sire of seven stallions and twenty-one mares,

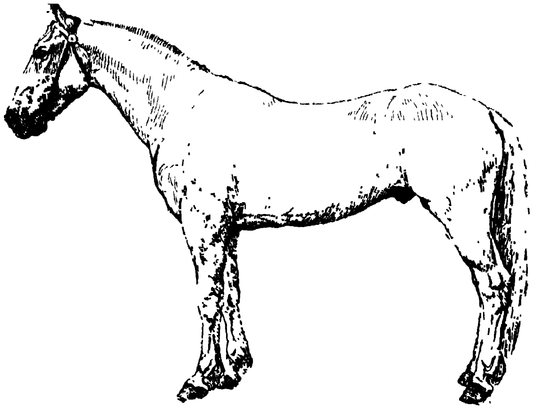


Fig. 474. Russian Orloff stallion.

one of which, Barss or Bars 1st, is an important factor in foundation blood-line descent. He was foaled in 1784 and died in 1808. The dam of Bars was a big Dutch mare of fine knee action, and from this ancestry comes the size and action desired.

Count Orloff used English Thoroughbred mares for many years in his stables, and they were bred to Orloff stallions, but no stallions were ever sold from this stud. In-and-inbreeding was finally actively followed in one group, while another group of Orloff and English blood stock was maintained. In 1845, the Russian government bought the Orloff stud from the Countess Orloff, daughter of its founder, when there were 21 stallions and 194 brood-mares of the Orloff breed, and 9 stallions and 112 brood-mares of Orloff-Hackney blood.

In America. There have been a number of importations of Orloffs to America. In 1877, four stallions and one mare were brought over and sold at auction, all being purchased by Lieutenant Ismailoff of the Russian army. In 1890, Jacob Heyl, of Wisconsin, imported two black stallions, and, in 1892, two stallions and four mares. One of these stallions, Wzmakh, made a record of 2:21¼. This same year F. G. Bourne imported five stallions and one mare. In 1893, eighteen head were imported from Russia for exhibiting at the World's Columbian Exposition. In 1902, Bergh & Company, of New York, imported twenty-eight head, which were sold at auction in New York, at an average price of $1,243. The breed has never secured any permanent foothold in America.

Distribution.

The Orloff is generally distributed over Russia, and is the predominating trotting horse of that country, although other breeds occur. It has no distribution to a great extent outside of Russia.

Types.

There are several types of the Orloff, and, of those exhibited in 1893, criticism was made of the difference in type. Mr. M. W. Dunham, who judged the breed at Chicago, especially commented on this variation. Mr. Dunham, at that time, was one of America's most noted importers and breeders of French coach horses, and was well qualified to judge. He commented in particular on a heavy, coarse type, and a fine, light type. Coarseness of form is given as a reason for the unpopularity in America. Without doubt, the Orloff does not show any greater variety of type, however, than does the American trotter, although the latter unquestionably possesses much more speed.

Uses.

For driving.—The main use of the Orloff is for driving to carriages of the lighter type or to sleigh. It is not used under the saddle, but in general service compares well with the American roadster or trotter of the heavier type. For long-distance trotting the speed of the Orloff is very satisfactory, surpassing the American trotter. For short distances it is inferior to the American.

For crossing.—The Orloff has been crossed with the American trotter with the best of results. When the dam is an Orloff, the offspring frequently shows more speed than the sire. Little attention has yet been given to this cross in America, but in Russia it has found more favor.

Organizations and records.

The Russian government especially promotes this breed in its own stud, and what is known as the Record of the Imperial Russian Horse Breeding Society, represents the Orloff officially. In 1906, during the serious internal dissensions in Russia, press reports stated that one of the government

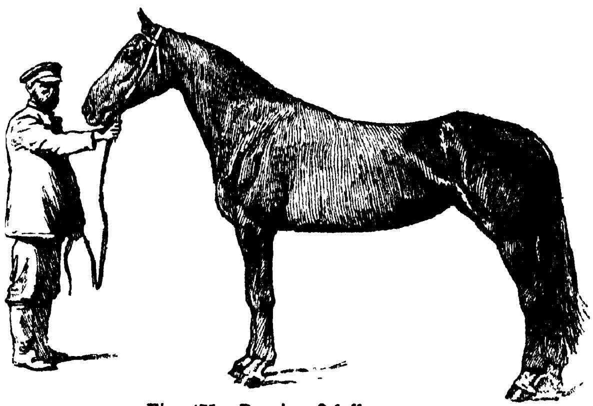


Fig. 475. Russian Orloff mare.

studs was seized by rebels, the buildings detroyed and many valuable pure-bred horses burned.

Literature.

The Orloff Horse, Country Gentleman, Vol. 68, p. 330; Orloff Horses, Breeders' Gazette, August 16, 1893. [For further references, see page 416.]

Pacing Horse, Standardbred. Fig. 476.

By *John A. Craig.*

The pacer is not a separate and distinct breed of horses. The name is applied to a class of horses that are characterized by the pacing gait. The American Standardbred trotting horse breed is the most potent source of pacers.

Description.

It was a prevalent opinion some years ago that there was a type evolving among pacers, but this has been largely dispelled. Dan Patch (Fig. 476) is as smooth and graceful in line of mold as it would be possible to conceive an ideal, and Joe Patchen is considered among horse-lovers, no matter what their preference as to breed, as being very nearly a model in finish, symmetry and style. So many old-time pacers were steep in the hind-quarters and some crooked in the hocks and pitched forward, that it became the opinion of a coterie that a pacing type was being evolved. Time demonstrated with the pacer as with the trotter, that symmetry and graceful lines and style in action or repose were not opposed to speed.

History.

From the earliest writings referring to horses and from the earliest representations of them in sculptured frieze, we learn that pacing or ambling was a gait common to the horse in earliest times. This gait is shown in Greek sculpture and referred to in the publications of some of the earliest writers in Spain, Great Britain and America. It is unnecessary here to recount these early references, for they are accessible in nearly every work devoted to the horse; and it is equally unnecessary to attempt to locate the origin of the gait, for there is no feature connected with the history of the horse that depends more on legendary lore than this. Suffice it to say that in Spain, where the saddle horse as a pack animal and for traveling was much in vogue, the pacing or ambling gait was considered a very necessary attribute; and the same is true in perhaps a lesser degree when the early history of the pacer in Great Britain is considered.

In America.—It is in America in colonial days that the pacer in the New England states seemed to reach the highest point of utility; from there and from Canada the pacer seems to have spread. The Narragansett pacer of Rhode Island attained a wide notoriety over the New England states in colonial times, but with the improvement of roads and the abandonment of horse-back riding for long-distance traveling, this strain became extinct. Whether or not it drifted over into Canada and formed the foundation for the remarkable number of pacers common to the Province of Quebec, is not definitely known, nor is there any other satisfactory supposition as to the origin of the Canadian pacing families. It would seem more plausible to account for the Canadian pacers in this way than to accredit them to French origin, for they were very dissimilar to the French horses of that time in their characteristics.

The theory that the French-Canadian pacer is an offshoot of the Thoroughbred has also been advanced and in some instances it may be proved, but in most instances the originator of the strain was by a Thoroughbred out of a pacing mare. Again, it has been asserted that the French-Canadian horse is a descendant of the French Percheron, reduced in size by the more vigorous conditions of climate. This seems to the writer the most untenable of all the theories. Long observation among the more common types prevalent among the French-Canadian people, and attendance at their winter ice-racing, where the most of those with speed would congregate, substantiate the writer's opinion. In all its characteristics the French-Canadian comes nearer the Morgan in some traits and nearer the Thoroughbred in others, than those of any other breed or family. While like the Morgan in type and style of going when trotting, yet it must be admitted there are very few pacers among the Morgans. Also, not many of the Thoroughbreds pace unless there is a strain of pacing through the dam's side. The French-Canadian families, especially those showing inclinations to pace, although most of them were double-gaited, have in time become submerged in the foundation of other families which are now of most prominence. Among the Canadian families of early origin, the most noted spring from Copperbottom, Pilot, Daniel Boone, Drennon, Davy Crockett, Corbeau, St. Lawrence, St. Clair. Of those of more distinctly Thoroughbred origin, might be mentioned Smuggler, Clear Grit, Uwharie and Hiatogas, while perhaps the two most noted of all, the Hals, springing from Tom Hal in Tennessee and Blue Bull from Indiana, had their origin so shrouded in misty legend that it is not even advisable to speculate on it. From all that we know, it may be safe to assume that the Thoroughbred horse has had as much to do with the evolution of the pacer as any other up to the time of the introduction of the standards, although we have to admit that there seems to have been an original stock on which the Thoroughbred, as a scion, was grafted with more or less success.

The Copperbottoms and Pilots made a reputation in Kentucky at an early time; the Columbus family did the same in New England, the St. Clairs in California, the St. Lawrences in Michigan, the Blue Bulls in Indiana and Ohio, the Hiatogas in Virginia, and the Hals in Tennessee. While all these were in a general way known as pacers, yet with most of them the gait was interchangeable, and many of them could trot as fast as they could pace, and very few of them sired a majority of pacers. As might be expected, the fastest of their get were pacers, and those made the reputation of the sire, while as a matter of fact that sire would be getting mostly trotters. For example, Blue Bull, a fast pacer himself and a getter of some fast pacers, sired fifty-six trotters out of a total of sixty of his in the list. So also with many of the others, with the notable exception of the Hal family. This is the leading family of pacers that is justly entitled to be called a family of pacers,

and the writer does not know of any other like it, pacing in origin and breeding on at the pacing gait.

What has been written may enable the reader to understand the position of the pacer in the earliest days. But to explain the position in our own day is almost beyond the possibilities of the most earnest student, so intertwined in breeding and development are the trotting and pacing gaits. When the standard for Standardbred horses was established, pacers and trotters came in on almost equal footing. At the races, too, trotters and pacers at that time mostly competed on equal footing, many of the purses being open-class for trotters or pacers. It was soon found that the pacers were naturally faster than the trotters, for they would win most of the races when both competed on equal footing. The craze for speed and the desire to put the get of stallions in the list, increased the popularity of the pacer at a bound.

It was found, too, that it was a very easy matter to change the gait of most horses from trotting to pacing, especially with the use of hobbles or hopples, as they are interchangeably designated. This leads us to say that the difference in the gaits is simply that in the pacer the two legs on the same side move together, while in the trotter the movement is diagonal (see page 423). By putting a horse in hobbles, he must either pace or break the hobbles, which are so strong as to be almost unbreakable, or be thrown. Hobbles have been permitted in races, but owing to the danger to the driver if any entanglement occurs, they have not become popular except to keep horses that show a tendency to pace at that gait or train them until they can do without them. At its meeting on February 5, 1908, the American Trotting Register Association adopted a resolution against the use of hobbles. It was found that a change in the shoeing, such as shoeing very light all round, would encourage a horse to pace; and even the shifting of the bit would accomplish the same purpose.

After the craze for speed at any cost had subsided somewhat, and a different time limit set for the pacer before he could become standard, the winnings possible for green trotters increased, and with that the purses and colt stakes for trotters were augmented so that trotting as a part of the sport of racing became again more than on a par with pacing. The pacing standard now in force is appended. It should be said that it is identical with the trotting standard except that the word "pacer" is substituted for the word "trotter" and the word "pacing" for the word "trotting," and the speed standard is changed from 2:30 to 2:25; furthermore, Rule 6 is an addition.

The pacing standard.—"When an animal meets these requirements and is duly registered, it shall be accepted as a Standardbred pacer:

"(1) The progeny of a registered standard pacing horse and a registered standard pacing mare.

"(2) Any stallion sired by a registered standard pacing horse, provided his dam and granddam were sired by registered standard pacing horses and he himself has a pacing record of 2:25 and is the sire of three pacers with records of 2:25 from different mares.

"(3) A mare whose sire is a registered standard pacing horse and whose dam and granddam were sired by registered standard pacing horses, provided she herself has a pacing record of 2:25 or is the dam of one pacer with a record of 2:25.

"(4) A mare sired by a registered standard pacing horse, provided she is the dam of two pacers with records of 2:25.

"(5) A mare sired by a registered standard pacing horse, provided her first, second and third dams are each sired by a registered standard pacing horse.

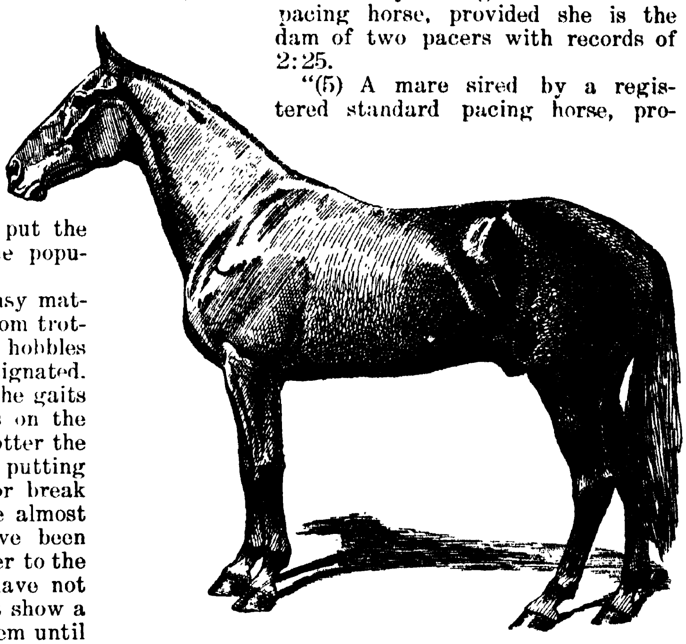


Fig. 476. Dan Patch, 1:55¼.

"(6) The progeny of a registered standard trotting horse out of a registered standard pacing mare, or of a registered standard pacing horse out of a registered standard trotting mare."

Distribution.

From the New England states and Canada, especially Quebec, the pacer was gradually scattered all over America, and is now found more particularly in Tennessee, Kentucky, Ohio, Missouri, California and Indiana.

Families.

Among the modern Standardbred horses it is not possible to separate the familes into those that pace as a family characteristic, and those that trot. The Hal family is composed most distinctly of pacers, for Tom Hal Jr. has fourteen in the list, all pacers, while Brown Hal, one son, has seventy-eight, all pacers. The latter has two noted sons, Star Pointer, with fifteen in the list, all pacers, and Hal Dillard with forty-two in the list, only three of which are pacers. In some instances there is a union of one of the leading families with the Hal

strain which produces pacers consistently. For instance, Direct, 2:05½, of the Dictator family is a pacer and has sired forty-two pacers and thirty-seven trotters. He sired Direct Hal p., 2:04¼, the sire of nine in the list, all pacers, and the fastest green stallion of 1907. While some of the families of Standardbreds show a stronger tendency to trot than to pace, the reverse is not common, although it is possible that in time this may result, as it is ostensibly the aim to establish two separate standards. The champion pacing stallion, Dan Patch, 1:55¼ (Fig. 476), is sired by Joe Patchen, a noted race horse and a pacer, sired by Patchen Wilkes of the George Wilkes-Mambrino-Patchen cross; and the dam of Joe Patchen was by Joe Young of Morgan breeding. The dam of Dan Patch was Zelicia by Wilkesberry, which was a Wilkes on his sire's side and a Clay on his dam's. There is very little of what might be called pacing blood in her pedigree, although the Wilkes strain and the Abdallah 15 strain have produced many fast pacers. On the other hand, Lou Dillon, the champion trotter, 1:58½, comes as near being of a pacing line through her sire as almost any noteworthy pacer. She is by Sidney Dillon, no record sire of eleven trotters and eight pacers, by Sidney, pacing record 2:19¾, sire of sixty-three trotters and forty-seven pacers, including Citation 2:03¼, the pacing queen of 1907. Sidney is sired by Santa Claus, 2:17½, trotting horse and sire of nineteen trotters and six pacers. At present it does not seem likely that the pacing families will become separate from the trotting families.

Uses.

For racing purposes the pacer cannot be said to equal the trotter as a money-maker, as the purses are not generally so large; and the colt stakes for the trotters are also large. For road purposes in general, the pacer is not so popular as the trotter, although for matinee uses it is held in high favor. For the speedway, the pacer is decidedly popular for several reasons. One is that in brushing, a pacer can get away quicker than a trotter; and usually, also, it is the faster gait. Pacing is an easier gait, and in pacing a horse does not strike the pavement so hard, a matter of some consideration on hard roads. For usage on common roads or in snow, the pacer cannot be said to be as popular as the trotter. The pacer has not, as a rule, so evenly a rated gait as the trotter. Very often it is a slow amble or full speed. However, many pacers jog-trot, and when forced to full speed at a trot strike into a pace when urged to do more.

It is considered by some persons that the pace is an ungainly gait, but it is to be remembered that, like all other gaits, there is a difference in the classes of it. Some horses pitch in such a way as to be lumbering in gait, but others go as true and as frictionless as the piston of an engine. Again, for road-riders, the pacer does not develop, as a rule, into a puller, which is sometimes so true of the trotter. While the pacing gait is generally considered to be the faster of the two gaits, five seconds is thought to about express the difference in time. The pacer, as a rule, needs the lighter road rig, for the trotter seems to have the advantage slightly in pulling power.

Organizations and records.

The same registries and the same associations look after the interests of the pacers as those that have the Standardbred trotter under their auspices. [See page 507.]

Percheron Horse. Figs. 42, 477.

By *Charles F. Curtiss* and *John A. Craig.*

The Percheron draft breed of horses is native of the ancient province of La Perche, a territory about one hundred miles square, in the north-central part of France. This region lies in the heart of a fertile farming country. The land is high and rolling, the soil is fertile and the farms are watered by numerous springs and small streams. These springs and brooks give rise to some eight or ten rivers flowing into the English Channel on the north and the Atlantic ocean on the west. The numerous valleys are rich and they produce sweet, nutritious grasses and bountiful crops of grain. The climate is mild, yet sufficiently tonic and invigorating to produce horses of good temperament. The land is held mainly by tenant farmers who are frugal and thrifty, and good tillers of the soil. The natural conditions of this region all combine to make a most favorable environment for this widely known and popular breed. Among the breeds of draft horses that have been imported to America from France, the Percheron leads both in numbers and in popularity.

Description.

Nearly a century ago the aim of the breeders of horses in La Perche was to produce a medium-weight draft horse, suited in type and action for pulling a "diligence" or omnibus. At an early day, the demand existed in France for a horse that could haul a load at as rapid a rate as possible. At this time, the breed was represented by horses of upstanding type, somewhat rangy but strongly built, with attractive and unusual action for draft horses. They were then gray in color, and these were the first to be brought to America. While not so drafty in type as the modern Percheron, they were horses of superb style, full of vigor, and they had powerful action which enabled them to pull strongly and more quickly at the same time. In themselves, the gray Percherons of early days were unusual draft horses, and it was the degree to which they combined activity with pulling power that made the Percheron a very popular horse for farm work. But the demand in America became more insistent for a heavier, blockier, shorter-legged type, that would grade the produce of our lighter mares to a draft weight quicker. This demand resulted in the modern black Percheron of somewhat stouter build, deeper body, more weight, and as much quality as the prototype; but there was some sacrifice of style, standing or going, with somewhat less attractive action.

The modern Percheron approaches more closely the essentials of a draft horse to meet modern markets, but the old type had some qualities, such as style, endurance and activity, which were difficult to retain in a shorter and stouter built horse of more weight.

The present-day Percheron's excellencies are to be seen in the active temperament, intelligent head, deep body, wide muscular croup and clean-cut legs of the typical representative. The joints are usually clean and hard, and the legs invariably show an abundance of quality that guarantees durability; but frequently the set of the legs and, particularly, the shape of the hind-quarters, is at fault. A croup too sloping, with deficiency in muscle below, cannot give the greatest pulling power, especially when associated, as it often is, with legs that are improperly set, being either too straight, sickle-hocked or otherwise cramped in the hind-quarters. The Percheron is rarely deficient in quality and activity, and when the weight is sufficient to meet the demands of the modern draft-horse market, a draft horse of unusual excellencies is the result. The action of the Percheron is almost always quick enough for a draft horse, and the feet are generally picked up with snap at the walk; but these should not be allowed to overshadow desirable mechanical action, which is straight and distance-covering, although less showy and attractive.

In size, the Percheron ranges from fifteen and one-fourth to sixteen and one-half hands, and from 1,500 to over 2,000 pounds in weight. There are a number of medium size, although the largest take rank with the largest of any of the draft breeds. In France there is a type smaller in size than the medium. These are popular for general traffic and for bus and tram use in cities. The demand in the United States is for the larger types.

History.

France has long been noted for good horses. The horses of France, like those of other countries, were first improved for the purpose of war. The Flemish blood was largely drawn on in early times and importations of oriental blood were made at a very early date. This blood was infused with the native horse stock of France, which may have been Flemish in its origin. The oriental blood imparted a degree of refinement and finish that has ever since characterized the modern draft-horse stock of France.

Since 732, when the French defeated the Saracens and captured their horses, infusions of Arabian blood have been made, and the subsequent use of Arabian stallions on the native mares continued as late as 1820. In this way, a foundation was laid for a breed of horses possessing activity, quality and strength. The extension of railroads, reducing the use of the omnibus, seems to have diverted the breed towards a heavier type. This led to the use of Flemish stallions. The conditions of La Perche being favorable for the growth of strong active horses, the breed started in this way made very rapid progress. There are some features of French management that may have had an influence also in directing the development of the breed. It is a common practice to work the stallions, and this may have been a factor of some influence on their dispositions, making them more amenable to work.

It should be said that the French government recognizes several breeds of draft horses, but the Percheron and the Boulonnais are apparently the only two that may be considered pure, as they have studbooks separate from the others. In addition, there are the Breton, Nivernais and Ardennais, all of which may be recorded in the General Draft Studbook of France. [These breeds are discussed on pages 460–462.]

In addition to controlling the matter of registration, the French government has a system of inspection, which in some degree assists its horse-breeding interests. The veterinary inspection, however, is limited to periodic ophthalmia or moon blindness and roaring or thick wind. Johnstone (The Horse Book), states that there are only two maladies for possession of which approval, authorization or certification is refused in France—periodic ophthalmia and thick wind. This being so, the branding systém carried out by the French government does not carry so much weight as is commonly supposed, for inspection apparently only discriminates against these two diseases, and there is nothing in the law to prevent any breeder using such unsound stallions on his own mares. The author referred to states

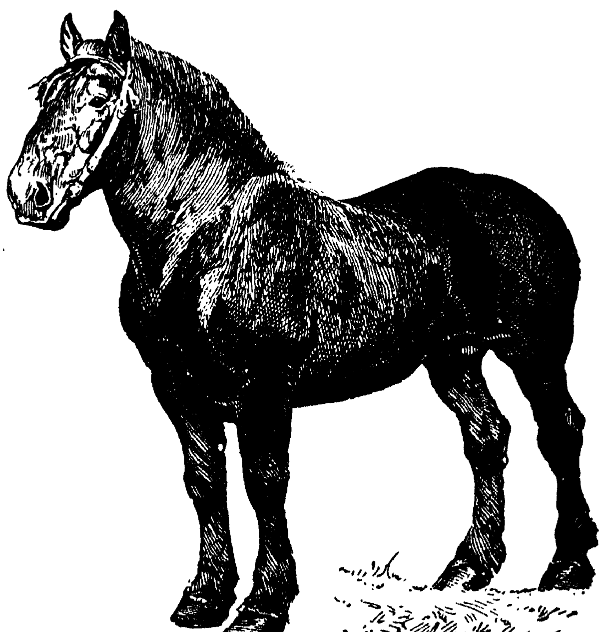


Fig. 477. Etradegant. Champion Percheron stallion at all leading live-stock shows in America in 1906.

further, that when a stallion is pronounced free from the unsoundnesses named, he is branded on the neck under the mane with a five-pointed star. The colt must be over thirty months of age before

he can stand for public service, and the certificate of freedom from these diseases covers only one year. If the colt fails to pass inspection for these diseases, or if the diseases develop after the inspection, then the letter "R" meaning refused, is branded over the five-pointed star. These are the only brands used by the French government.

The French Percheron Society, however, uses a brand that is put on all stallions and mares recorded in its studbook. It is a monogram of the letters S. and P., the initials of the society. It is branded on the neck under the mane.

After successfully passing the inspection, the horses are classified in three grades. The first are known as "subsidized" or "approved," and to such a cash bonus is awarded to keep them in France on the owner's farm, and available to outside mares. The other two are "authorized" and "certified," neither of which carries with it any subsidy.

In America.—The first importation to America was made in 1839, by Mr. Edward Harris, of Moorestown, New Jersey. The next importation was made in 1851, by Messrs Fullington and Martin of Milford Centre, Ohio. This importation was of far-reaching importance, although it consisted of but a single horse named "Louis Napoleon." This horse was sold and taken to Illinois in 1856, where he afterward passed into the hands of Mr. Dillon, of Normal, Illinois. "Louis Napoleon" stood fifteen and one-half hands high and weighed about sixteen hundred pounds. He was, perhaps, the most noted horse of the breed that has been brought to America. It is estimated that he sired over four hundred colts that were used successfully for stud purposes. In 1851 and succeeding years, other importations were made which helped to lay the foundation of the breed in America. In 1870, M. W. Dunham, of Wayne, Illinois, took up the importation, since which time he has imported and bred Percherons very extensively. Through his efforts the breed has gained much popularity in America. Many other importers might be mentioned, but the list is now a long one, as the importations of horses of this breed have been very extensive. The Percheron breed has made rapid progress in popularity in this country. It is the most numerous and the most generally popular of any breed of draft horses in America. This is accounted for chiefly by the degree to which the Percheron is adapted for the work on the majority of our farms, as well as to produce an active draft horse for the market.

Distribution.

The Percheron breed has proved generally popular in nearly all parts of the United States, particularly in the farming regions where draft horses are raised for market. It is well adapted to farm conditions and meets with favor on the markets. Plumb (Types and Breeds of Farm Animals) quotes Weld as authority for the statement that in 1866 there were fully 5,000 Percherons in this country. Illinois has been the chief center for the breed, with the adjoining states of Ohio, Iowa, Michigan and Wisconsin following with lesser numbers. The same author states that between 1851 and 1883 nearly 4,000 Percherons were imported or bred in the United States, and these were distributed about as follows: Illinois, 1834; Ohio, Indiana and Michigan, 577; Wisconsin, Iowa and Minnesota, 424; New York, Pennsylvania and New Jersey, 280; Missouri, Kansas and Nebraska, 186. These figures are an index of the relative extensiveness of the Percheron breeding interests today, although it is likely the western states carry more compared with the others than they did at that early time. The southern states have become an altogether new field for the Percheron, although not many of the breed have been brought into the South or into Canada, where the British breeds seem to be in more favor. Wilcox (Farm Animals) has stated that there are 30,000 registered Percheron horses in the United States, which is a decidedly larger number than any other draft breed may claim.

Uses.

The Percheron has little use except as a draft horse and as a producer of grade draft horses. The usefulness of this breed for draft purposes is so well known that it is unnecessary to dwell on that feature. But it is well to call attention to the fact that a large proportion of our draft teams contain Percheron blood, and that the results which follow a cross of a pure-bred Percheron stallion on a mare of other draft breeds, or even on the heavier types of our common mares, are most excellent.

Organizations and records.

In France, the interests of this breed are in the hands of Société Hippique Percheronne. It was organized in 1883, and in that year published its first studbook. The Percheron Society of America has published nine volumes of the Percheron Studbook of America, the first two volumes, however, having been published by the Percheron-Norman Horse Association. The Percheron Registry Company has published three studbooks.

There have been many dissensions among the importers and breeders of French draft horses, leading to the formation of several societies and studbooks. It becomes necessary to discuss these, not because of any desire to state which were right or which were wrong, but solely for the purpose of explaining the status of the societies and studbooks at present representing the breed.

The first importations of draft horses from France to America were almost universally called Normans. There was no apparent reason for the name, for none of them came from Normandy. This name at that time was intended to embrace all the breeds of draft horses in France. Those importers bringing horses from La Perche, considered the horses from that district the typical draft horses of France. The French government had not at that time established the Percheron studbook (its publication was begun in 1883), consequently there was more room for the discussion of the claim at that time than there is now. In 1876, when the importers of the French draft breeds organized and issued the first studbook

Plate XVI. Small horses. Shetland pony stallion. Cowboy and broncho, a typical western outfit

under the editorship of J. H. Sanders, a compromise was effected by the adoption of the title Percheron-Norman Studbook. Some of the members withdrew, forming another association, which published the National Register of Norman horses, and this was afterwards changed to the National Register of French Draft Horses. In this studbook are registered all importations that are registered in the General Draft Studbook of France. The Percheron-Norman Studbook was changed to the Percheron Studbook, and it is based on the Percheron Studbook of France which, since 1885, has accepted for entry only horses whose ancestors are registered in the book. As the present studbooks stand, only pure-bred Percherons may be recorded in the Percheron Studbook, while in the Register of French Draft Horses all the draft breeds of France, including Percherons, may be admitted. From this unfortunate diversity of studbooks, the Percheron Studbook had reached the point of being recognized as the distinct representative of the Percheron breed, when internal dissension arose over the powers vested in the secretary. The outcome has been a division into three associations that have published or intend to publish studbooks. The American Percheron Horse Breeders' and Importers' Association was organized in 1902, but in 1905 this name was changed to the Percheron Society of America, with headquarters at the Union Stock Yards, Chicago. Also in 1904, the Percheron Registry Company was organized with headquarters at Columbus, Ohio. In 1905, the American Breeders' and Importers' Percheron Registry was organized, with headquarters at Plainfield, Ohio.

Literature.

Charles Du Hays, The Percheron Horse, New York (1868). [For further references, see page 416.]

Ponies. Figs. 478–486.

By *S. B. Elliot.*

The dividing line between the horse and the pony was vague and undefined until the Hackney Horse Society was established in England in 1883. All horses measuring fourteen hands or under were then designated ponies, and registered in a separate part of the studbook. This standard of height was accepted and officially recognized by leading agricultural and horse-show societies in England, and subsequently in America. In 1905, the American Hackney Horse Society increased the height of ponies to fourteen hands one inch, and in the case of polo ponies the limit of height had previously been raised to fourteen hands two inches.

Adverse climatic conditions, promiscuous breeding and privation have had much to do with the development of most breeds of ponies. Distinct types of ponies are found in almost every country, the chief types being the Arab and his near allies, the Turks, Barbs and Persians, the Mongolian, Japanese, Korean, Burma and Manipuri pony, Sumatra and Java pony, Russian, Scandinavian or Norwegian pony, the Celtic or pony of Iceland, the ponies of the British Isles, and, in America, the ponies of the western states. While some of these, perhaps, are only of remote interest in America at present, it has been thought best to discuss most of them briefly. The following index will aid in finding the separate discussions.

Index

Use and value of the pony.

The usefulness and value of the pony is just beginning to be appreciated in America. Ponies cost much less to feed, consume less and thrive on rougher food than the large horse, and they will travel as far; many, in fact, will outdistance the large horse. The thirteen-hand pony will do a horse's work on half his feed and requires less attendance. Ponies have better feet, legs and wind, and are less susceptible to disease than large horses. They stand more hardship, recover more quickly from fatigue and live longer. They have, moreover, much greater intelligence, and for this reason are much less likely to take fright at objects on the road.

The principal cause of the marked superiority in constitution of the present-day pony over the horse, and of his greater intelligence, is accounted for by his having to shift for himself on the hills and wastes, and this hardiness and intelligence is transmitted to generations born in domestication. The horse reared in captivity with everything done for his comfort, has not the same toughness as the pony; no demand is made on his intelligence, and his mental faculties remain, to a great extent, undeveloped. In the pony, unsoundness of wind or limb is almost unknown. For generations ponies have been accustomed to pick their way up and down stony precipitous hillsides. Their feet and legs consequently are of the very best, and they are remarkably sure-footed.

History of horses in warfare is replete with accounts of the endurance of ponies and their ability to thrive on poor and scanty food. Sir Walter Gilbey, in "Ponies, Past and Present," gives an interesting account. Sir Teddy, a twelve-hand pony, raced with the London mail coach to Exeter, a distance of 172 miles. He was led between two horses all the way, and carried no rider, performing the journey in 23 hours and 20 minutes, beating the coach by 59 minutes. Mr. J. C. Appleby, in

his book, "Nimrod," mentions the fact that during the drawing of the Irish lottery the news was conveyed by express from Holyhead to London, chiefly by ponies, at the rate of nearly twenty miles an hour. Mr. Whyte, in his "History of the British Turf," gives an account of a thirteen-hand three-inch mare belonging to Mr. Daniel Crocker, that in April, 1754, traveled 300 miles on Newmarket Heath in 64 hours and 20 minutes, which was 7 hours and 40 minutes better than the time for which she had been backed to perform the journey, namely, 72 hours. On one of the days, Tuesday, April 23, she went 108 miles. The day before and the day after she covered 96 miles each day. She was ridden by a boy who weighed 65 pounds, and this did not include saddle and bridle. In our own country there are many accounts of endurance of western ponies.

Nor is it only in endurance that the pony excels. His greater stamina is also evidenced in his length of life. The following instances in which ponies have attained to great age are cited by Sir Walter Gilbey: "Mr. Edmund F. Deane, of Gaulstown Co., Westmeath, lost a pony in December, 1894, which had reached the age of 39 years; in 1896, Mrs. Pratt, of Low Pond House, Bedale, Yorks, lost a pony mare aged 45 years; on Christmas Day, 1863, there died at Silworthy, near Clovelly in North Devon, a pony that had arrived within a few weeks of his sixtieth year. Accounts of ponies which lived, and in some cases worked, until they reached 40, 38, 37 and 35 years also recur to mind."

Ponies in America are used chiefly for children's purposes and for playing polo. In Europe, in England particularly, they are used for a much greater variety of purposes. Some are used in coal mines, but a great many more are put to use above ground. Large numbers are employed on light delivery wagons. Green grocers, fish mongers, market men, small merchants, all make use of them for delivery purposes. Country gentlemen, doctors, land agents, in fact all persons having occasion to travel use ponies a great deal. There is good reason for stating that ponies could be used to far greater advantage in America than they are at present. For light work they could be used in many places instead of large horses at a considerable saving. Ponies in America, the western ponies in particular, have long been used for saddle purposes, but ponies as a first mount for children are just beginning to be appreciated.

The Polo Pony

The increasing popularity of polo is attracting much attention to ponies suitable for playing the game. Polo originally was an oriental game, being the national game of the Manipuri, from whom the Europeans first learned it. It was first introduced into India proper in 1864, and was first played in England by the officers of the 10th Hussars in the year 1872, on their return from service in India. It is now played in France and other parts of Europe, and is becoming very popular in America. The best type of ponies for playing the game are scarce and very costly.

This pony that is in such demand and brings such a high price, is really not a pony but a small horse. He does not necessarily belong to any distinct breed, and is generally a cross. The regulation height is fourteen hands two inches, and he must be a powerful, speedy, sound, handy animal, with great staying power and courage, high in front, with sweeping shoulders and good strong hocks. The necessary speed and courage are rarely found except in those ponies that have a preponderance of race-horse blood in their veins. He must be able to carry 160 to 200 pounds weight, make incessant turns, twists and stops at full speed, and make short spurts of hard galloping, all

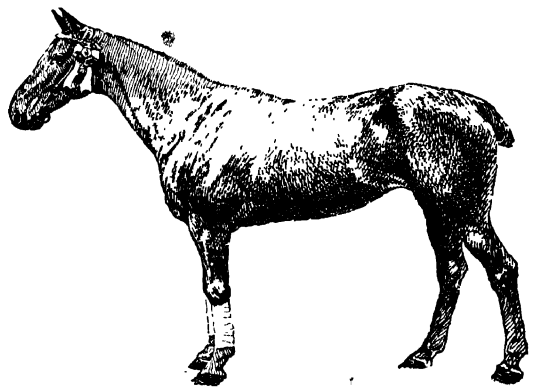


Fig. 478. A light-weight western polo pony. Battledor, fourteen hands, one inch.

of which take more out of a pony than would a race out of a race horse.

The Thoroughbred race horse has the speed and courage, but rarely the strong hind-quarters and the power necessary to enable him to stop quickly and turn sharply at the gallop. The Arab, while having great staying power, is rarely sufficiently speedy; and the Mustang has not the speed or the courage to make a good polo pony, even if he had the other qualifications. The best polo pony seems to be one that is three-quarters Thoroughbred. As laid down by Mr. E. D. Miller in his book, "Modern Polo," the polo pony should be a Thoroughbred out of a mare by a Thoroughbred,—that is, it should be three-quarters Thoroughbred race horse.

In America, the ponies used to play the game are secured chiefly from the West, and the demand for ponies here is not yet anything like what it is in England. The supply is entirely inadequate to meet the demand, and polo ponies are sought for the English market not only in America, including Canada, Mexico and Argentina, but in every corner of the horse-breeding world, principally in Egypt, Syria, Barbary, Russia, France, Persia, and South Africa. While the ponies thus secured are not equal in speed, endurance, or courage to the English or American race horse, the best, when trained and fitted, command very high prices. The prices may be said to range anywhere from $300 to $3,000. In fact, there is no limit to the price, as those who play the game, are, as a rule, men of means to whom a really good animal is cheap at

any price. The exacting qualifications, however, make first-class polo ponies rare.

Breeding polo ponies at present is somewhat of an experiment and presents many difficulties, the chief being the limit of height. All breeding of horses goes to prove the impossibilty of insuring the progeny of any given size. In America, the western pony mare is bred to small Thoroughbred stallions, and in a very few cases to Arabian horses. In England, to keep the size down, pure pony blood as foundation stock is being used to found a breed of polo ponies, the fillies being bred back to stallions of the same breed as their sires, the produce of which will be three-quarters Thoroughbred. The Thoroughbred race horse of late years has been increasing in height and small ones are likely to be only runts whose produce is likely to exceed the limit in height. The Arab in many ways is desirable, as he has the constitution, the endurance and the strength, but not the speed. The Arab, moreover, is more likely to be of the right size, and by reason of his great antiquity and the fixed character of the breed, he impresses more certainly and more markedly his likeness on his stock than any other breed.

There is generally a good demand for ponies that have been discarded from the game because of deficiency in speed, courage, or other essential qualifications. They make good hacks and often good saddle ponies for children and young persons. The pony Battledor (Fig. 478), with her fore-legs bandaged, as in playing the game, is a type of light-weight western polo pony.

A polo pony studbook has been started in England, and there is every reason to suppose that one will be started in this country in the near future.

The Mustang.

The ponies of the western states of America, the Mustangs, are in the case of those of the south-western states apparently of Moorish origin, com-

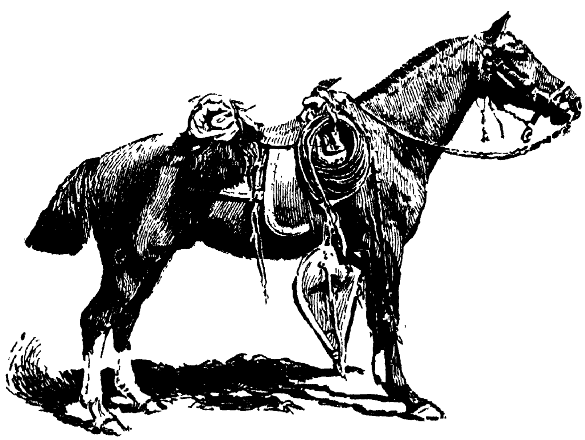


Fig. 479. A typical Broncho. Nigger

ing into this country by way of Mexico and having been brought over originally by the Spaniards. To these ponies the term Broncho is often applied, which is derived from the Spanish word "bronco," meaning rough or wild. The pony of the north-western states and Canada, termed Indian pony, appears to be of Norman origin, although often these two breeds are more or less mixed. Very

Fig. 480. A bucking Broncho.

many of the small horses at the present time in the western part of the United States have been crossed more or less with the American trotter, the English Thoroughbred or the Arabian horses. These still are known as Bronchos, although in recent years they are more commonly termed "cow ponies," from the use that is made of them in herding and driving cattle on the ranges.

The Broncho. Figs. 479, 480.

The Bronchos, like all horses in a semi-wild state, have good constitutions, and the best of feet, but because of inbreeding and want of selection, may not be good in general conformation. "In general, the Broncho is an exceedingly hardy, wiry little animal, possessed of considerable endurance. In the best types the head is small, clean-cut and refined, with bright, piercing eyes, small ears and attractive appearance, although many individuals have ill-formed heads. The neck of the better class is of medium length, well crested and very well carried. The body is short, deep and muscular. Bronchos are frequently ridden day after day for weeks at a time, without shoes, over the rough, rocky soil, carrying a heavy man and a cumbersome stock saddle. They weigh approximately 850 pounds, and are possessed of enormous strength for their size and weight." (W. L. Carlyle.)

These ponies of the Southwest, as a rule, do not exceed thirteen and one-half or fourteen hands in height unless cross-bred. Some of them are handsome, graceful creatures, but they do not compare favorably with the best American horses, or with imported European ponies, nor are they as good as the more northern Indian pony. They stand a great deal of hard work, however, and if broken young, could be made very serviceable. It is to be regret-

ted that this race of exceedingly useful and picturesque animals is decreasing, caused by the demand for a larger and more fleet horse by the cowmen and by crossing with Standardbred and Thoroughbred sires. The Broncho in the wild state can be ridden down and captured without much difficulty by good, domestic horses, even when carrying the weight of a rider, whenever it can be approached sufficiently close to allow anything like an equality in the start.

The Indian pony.

The pony of the northern states and northwest of Canada is a better animal than that of the southern states, although often they are inter-bred. The northern pony rarely exceeds thirteen hands, almost never fourteen, unless he is cross-bred, and is more compact, better ribbed up and a better boned pony than the Broncho. He is short in barrel and strong in limb, has very good feet, and often has considerable hair on his legs, heavy mane and tail, all of which would seem to indicate his Norman origin. These ponies are very hardy, and while not fast, will cover long distances with ease. They are, moreover, more intelligent, have better dispositions and display more courage than the Broncho.

Uses.

In the West these ponies are used for saddle purposes, especially for cow-herding, although they are fast being replaced by better horses. Ponies of both types are brought east and used in cities in delivery wagons and for light driving purposes, or as saddle ponies. The best of them are sometimes used as polo ponies. They are not bred, as a rule, except in the western states on large ranches, it being more profitable to raise other breeds of horses or ponies in the eastern states, where the cost of feed is so high. These ponies are used as foundation stock from which to breed a more improved type of pony or horse, the mares being bred to Hackneys, trotting, carriage, Thoroughbred race horses and Arabian stallions, often with a view to getting polo ponies. It is difficult, however, to get any pony or horse of much value from one cross.

Other American Ponies.

Aside from the Mustangs of the western states, there are in North America the Sable island ponies, the ponies found on the coasts of the South Atlantic states, and the Creole ponies of Louisiana.

The Sable island ponies rarely find their way into the United States, principally because of the duty. They are few in number and run wild, and are not so good as some other breeds from which selection can be had on the British islands. The Sable is a small pony much like the Celtic.

Ponies of South Atlantic states.—The ponies found along the coast of the South Atlantic states have been known to exist there for many years. They are apparently of Spanish origin, although somewhat smaller than the ponies of the western states. Little effort has been made to improve them and they are not superior in any way to the Mustangs.

The ponies of Louisiana, sometimes known as the Creole ponies, also appear to be of Spanish origin. They are somewhat smaller and finer in bone than the ponies of the western states, but are little different in other respects.

The Ponies of the British Isles.

Ponies have been known to exist in the British islands from the earliest times. They were there at the time of Julius Cæsar's conquest and he spoke highly of them. The ponies of the west of England are said to have been brought there by the Phœnicians when they came to trade for tin. The ponies of the northern part of the British isles, including the Shetlands, have many characteristics in common with the Scandinavian pony, and were probably introduced by the Scandinavian invaders some time prior to the fifteenth century.

Owing to the land system of the British isles, dating back to the feudal times, large estates have been held in one family for centuries, and the highest intelligence has been given to agricultural pursuits, to the breeding of horses as well as other animals, regardless of monetary considerations. The finest types of horses from the Shire and Clydesdale to the Shetland pony are secured from here for every part of the world. While, with the exception of the Hackney, the ponies of the British isles, like all other ponies, were originally the product of their environment, by improved methods of breeding, careful selection, the introduction of superior alien blood, and better keep, they have been greatly improved until the various breeds of ponies are unrivaled for symmetry of form, action and disposition. It is from these ponies largely that American breeders have to select their foundation stock.

The principal ponies of the British isles are the Welsh, Exmoor and Dartmoor, New Forest, the Scotch ponies, the Connemara or pony of Ireland and the Shetland pony. The last is discussed first because of its relative importance in America.

The Shetland pony.

The Shetland pony, the smallest of all ponies, is in many ways the most important in America. While in England and other countries he has been used extensively in the coal mines, in America his use is practically restricted to that of children, and as a child's pony he has no equal. Children and Shetland ponies seem to have for each other a natural affinity. Every child desires a pony, and as a considerable proportion of Americans have the means to gratify their children in such a desire, the Shetland pony is in great demand. It is imported in considerable numbers, and many are bred here. There are also many in America that are cross-bred.

The Shetland islands are situated to the north of Scotland, from which they are separated by about 150 to 200 miles of very rough and dangerous sea. There are some 120 islands, many of which are uninhabited, merely affording pasturage for a few sheep or ponies. The existence of two or three distinct types of ponies on private estates has given rise to the untrue statement that a more or less dis-

tinct type of the Shetland exists on each of several of the islands. There are no trees nor shrubs on the islands, the surface being a succession of hills of rock formation with peat and decayed vegetable matter in the basins and a light covering of soil on which heather and scanty grass grow, affording the only pasturage for the ponies.

Although far to the north, the climate is greatly moderated by the surrounding waters of the gulf stream. There is consequently much mist and precipitation of moisture, that accounts largely for the Shetland's very long, fine hair which in wet weather mats and is almost waterproof. This heavy coat is the Shetland's only protection against the inclement weather, as it is not housed, but is born, lives and dies in the fields, the hillsides and stonewalls being the only shelter from the winds that are constantly blowing, and which in winter are very penetrating.

Description.—The limit of height established by the Shetland Pony Studbook Society is ten hands, two inches. Ponies over this height cannot be registered, although in America the Shetland Pony Club has increased the height to eleven hands two inches. The average height of the pure Shetland may be said to be nine to ten hands. The size is more or less a result of the feed, and when food is supplied in abundance there is a gradual increase in size in successive generations. This increase is less apparent in highly bred ponies. The weight of mature Shetlands should approximate 325 to 375 pounds, for ponies of average height. The best specimens are compact in build, having deep body, heavy muscular quarters, short legs, short, broad back, deep, full chest, good bone, short, muscular neck, small head and ears, prominent eyes, and are very docile in disposition. In color, they are commonly brown, black and bay. There are other colors, such as dun, chestnut, gray and a few with white markings. Piebalds are not considered desirable, although there is a demand for broken colors in America.

The coat of the Shetland pony is a revelation to those who are not familiar with him. The young ponies under two years of age, in particular, have very long, shaggy coats. Towards spring the hair loses its luster and has a very rusty, shabby appearance. Owing to the hair being very fine and matted, it is shed in patches, often hanging in taglocks, which makes the pony the very roughest and shaggiest little creature imaginable. Once he has shed, his coat is fine and glossy and he is much more active in his movements. The mane is generally heavy and long, and adds much to the attractiveness of a well-kept pony.

The Shetland pony combines with the highest order of equine intelligence a disposition wonderfully free from vice and trickiness.

The Shetland stallion Howard B (Fig. 481) won first prize in the Shetland stallion class at the World's Columbian Exposition in Chicago in a class of nineteen, the largest class of Shetland ponies that has been exhibited to date in this country. The color of this stallion, while much sought after, is very unusual.

History.—Ponies have been known in the Shetland islands from the earliest times of which there is record. From the finding of the Bressay stone recently, there appears to be good evidence that they were there prior to the Norwegian invasion in 872. According to some early writers, the Scandinavian invaders introduced the foundation stock prior to the fifteenth century.

The government returns for 1891 gave the number of horses, which included ponies, in the Islands as 4,803, but because of the demand of recent years the ponies are steadily decreasing. While on a tour of the Islands in 1906, the writer made a careful estimate of the number of ponies, and could not account for over 4,000 of all ages

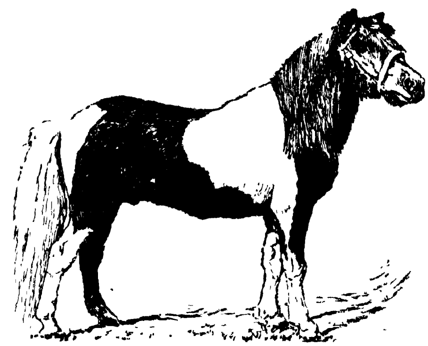


Fig. 481. Shetland pony stallion. Howard B, nine hands, three inches.

and sexes, and he doubts whether there are much over 400 foals produced on the Islands annually. In America there have been registered in the studbook about seven thousand of these ponies, and as the studbook has been open for about twenty years, this number includes those that have died in that time. The Shetland pony may be considered to be comparatively rare.

Feeding and care.—In the winter time, it is usual to feed the ponies. In April they are turned on common pasture lands to shift for themselves. In the autumn, the ponies come down from the hills and feed on the patches of fresh grass which have been preserved around the cultivated areas. In severe winters, when feed is scarce, they eat the seaweed. Contrary to the popular impression prevailing in America, the ponies do not run wild. They are all definitely owned and cared for more or less. There are few large herds. Most of the ponies are held by the crofters or farmers in small numbers.

Uses.—In the Shetland islands, the ponies are used little. They are sometimes employed in carrying peat from the hills to the crofts, and are the most wonderful weight-carriers in the world, a nine-hand pony being able to carry a full-grown man over rough ground for some distance. They are wonderfully hardy and will cover surprising distances. In the coal mines many of the ponies travel upwards of thirty miles a day, drawing a load of 1,200 to 1,400 pounds (on rails). In America, as has been said, the chief use of the Shetland is as a child's pony and for light driving. Shetland ponies are

very salable, the demand being far in excess of the supply. The smaller sizes are most popular in England, but not in America. They bring good prices, about as much at maturity as the average large horse, and are easy and inexpensive to raise.

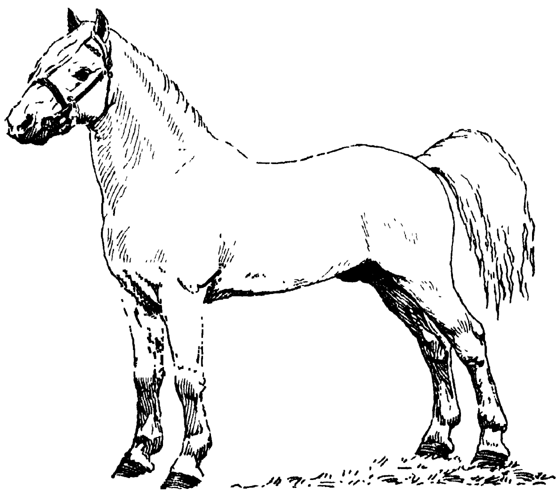


Fig. 482. Welsh mountain pony stallion. Greylight, twelve and one-half hands.

They break easily and are a constant source of usefulness and pleasure, as well as an ornament to any farm.

Organizations and records.—The American Shetland Pony Club was organized in 1888. The office of its secretary is at Lafayette, Indiana. Seven volumes of the American Shetland Pony Studbook have been issued. The Shetland Pony Studbook Society, with the secretary at Aberdeen, Scotland, is the official organization of the breed in Scotland and Shetland.

The Welsh pony.

The Welsh pony is more numerous than any other breed that comes from the British isles. It is difficult to discover the exact number, as there appear to be no statistics on the subject. He wanders over the hills and waste-lands of all the twelve counties of Wales, and also on the borders of Shropshire, Hereford and Monmouth. Inured from the earliest foalhood to the roughest and poorest pasturage, he is as sure-footed as the goat, has good shoulders, strong back, neat head, and the best of legs and feet. Many of the best Hunters in England trace their origin on the side of the dam to a Welsh mare. The breed has been improved from time to time by the introduction of superior alien blood, chiefly Thoroughbred, Arabian and Hackney.

The Polo Pony Society make two divisions of Welsh ponies, those of North Wales and those of South Wales. By the description given in Vol. 5 of the studbook of this society, the ponies of North Wales do not exceed twelve hands two inches. This refers undoubtedly to the Welsh pony in a pure state, as the writer has seen many Welsh cobs bred in Wales from Welsh mares and Hackney stallions that were fourteen hands and over in height. The pony of North Wales has straight legs, well-set-on tail and good shoulders.

The pony of the South Wales division seldom exceeds thirteen hands, and in a pure state is about twelve hands. The writer has seen many of them not over eleven hands. It is likely to be low at the withers, and have faulty hind-quarters, the rump being steep and the hocks sickled, although these defects are being overcome by improved keep of the young ponies and better breeding. The color of the Welsh pony most preferred is bay or brown. Gray or black is allowable, but dun, chestnut or broken color is considered objectionable.

The strength and endurance of these Welsh ponies is remarkable. They have legs that work cannot seem to destroy, and have wonderful carrying power. It is not uncommon in Wales to see a man weighing upward of 200 pounds riding one of these little ponies. As a rule, they have good carriage and action, and make desirable ponies for children who have had some experience in horsemanship. In England, they are used largely as a hack and by tradesmen. There are breeders using this pony as a basis from which to breed polo ponies, crossing with small Thoroughbred race horse or Arab stallions.

In America, Welsh ponies are used principally for children's purposes. Many are imported and a number are bred here. Now that the pony is becoming more popular, and the demand is increasing, the breeding of the Welsh pony should prove very profitable.

The pony Greylight (Fig. 482) is a fine specimen of the Welsh mountain pony. Among other prizes won in Great Britain, he has won first at the Royal, first at Bath and West, and first at the Welsh

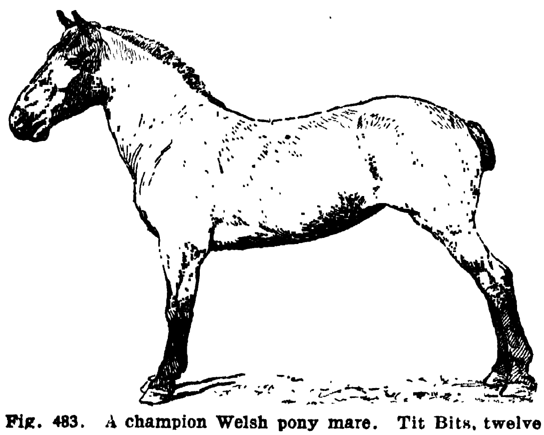


Fig. 483. A champion Welsh pony mare. Tit Bits, twelve hands, one and one-half inches.

National. The Welsh mare Tit Bits (Fig. 483), a beautiful specimen, has won a large number of prizes.

The organization interested in the improvement of these ponies is the Welsh Pony and Cob Society, with headquarters at Greenfield, Penybont, Radnorshire, Wales. At present there is no society in America.

Exmoor and Dartmoor ponies.

The ponies from those districts in England known as Exmoor and Dartmoor are much fewer in number than most of the other breeds in the British isles, and are rarely imported into this country. They range in height from eleven to thirteen hands two inches. The original color of the Exmoor was a buffish bay with mealy nose. It is supposed to have been brought to England by the Phœnicians when they visited the shores of Cor. wall to trade in tins and metals.

Studbook No. 5, of the Polo Pony Society, contains a description of the Exmoor pony. The average height is given as twelve hands. The best of the Exmoor ponies have strong backs and loins and good substance. They are generally bay or brown, with black points, wide foreheads and nostrils, mealy noses, sharp ears, good shoulders and backs, short legs and good bone. They are very tough and hardy, and have been known to cover long distances. Youatt states that in the year 1860, a farmer who weighed 196 pounds rode an Exmoor pony from Bristol to South Moulton, a distance of 86 miles, beating a coach that traveled the same road.

The official description of the Dartmoor ponies and those of North Wales is identical, with certain amendments in addition. Those ponies that are over fifteen hands would seem to be cross-bred, as the pure Dartmoor never exceeds thirteen hands. In color, the Dartmoor ponies are brown, black or bay. There are some grays. Other colors are considered objectionable. Efforts are now being made to improve them by the introduction of good stallions of the best pony breeds.

The New Forest pony.

Ponies have been bred in a semi-wild state from the earliest times in the county of Hampshire in England, a district covering some 92,395 acres, of which 44,978 are still unenclosed waste land. The greater part of this common land is poor and boggy moor. It is estimated that there are about 2,500 of these ponies. Like most of the other ponies in the British isles, they have been much improved in recent years. Lord Arthur Cecil owns a large number, and he turns out with his mares thirty to forty good stallions every season. Many of his stallions are from the island of Rum, off the western coast of Scotland, and are the original black Galloway, found in a wild state on the island in 1840, by his father, the late Marquis of Salisbury, and have been kept almost pure. In 1888, Lord Arthur secured the whole stock of these Rum ponies. They are inclined to be a little coarse in the head, but this defect is disappearing with breeding and good keep. Most of the Rum ponies are black, although some are bay or brown; many of them have the hazel eye, although this is not unknown in the Exmoor and Welsh ponies also.

The New Forest pony, because of not having had to endure the severe climate of the hills, is likely to be less hardy than the hill ponies. The height, as given by the Polo Pony Society, is twelve to thirteen hands. The writer has seen some of these ponies in England, and they are not equal to many of the other breeds, but Lord Arthur Cecil is very enthusiastic about them, and is doing much to improve them. They are likely to be low at the withers and not good in the hind-quarters, being droopy and cow-hocked. The cross of the vigorous Rum pony, however, will do much to correct this, as he is very strong in these points, having excellent hind-quarters and good shoulders. Aside from the Rum ponies, Thoroughbred and Arabian stallions are also being used, with marked improvement.

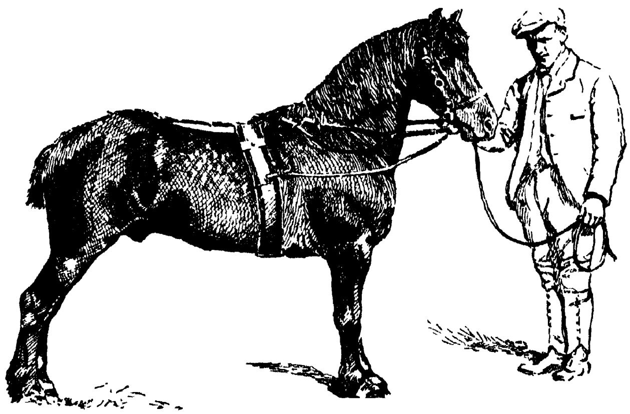


Fig. 484. English West Mooreland Fel pony stallion. Mountain Hero II, twelve hands.

The New Forest ponies are generally more spirited than most of the other British ponies. Like all ponies that have been brought up on poor pasturage, they improve wonderfully on good keep, and, with careful selection in breeding, astonishingly good results may be obtained.

The organization concerned with the interests of this breed is known as The New Forest Pony Association. There is no organization in America for this breed.

The Hackney pony. Figs. 470, 473, 485, 486.

The Hackney horse has long been bred in England and owes his present status to the most careful methods of breeding, rearing and training. Contrary to the impression given by his name, he is not a hack, but is, on his native heath, the highest type of driving horse. In 1883, when the Hackney Horse Society was formed in England, the standard of height for the pony was established as fourteen hands, and a separate part of the studbook was set aside for the registration of ponies. Subsequently, this height was increased to fourteen hands one inch, and about two years ago the same height was adopted by the American Hackney Horse Society, established in 1891. Inasmuch as the Hackney brings a higher price, both in England and America, than any other pony, he may be considered the most valuable of all ponies. In America, as in England, judging from the demand and prices paid, he appears to be steadily growing in popularity.

[The Hackney pony is the small-sized Hackney horse. For fuller notes, see *Hackney horse*, pp. 464–468.]

The ponies of Scotland.

Because of the proximity of the Shetland islands to Scotland, there are many Shetlands there, as in fact there are in England, and many of the ponies

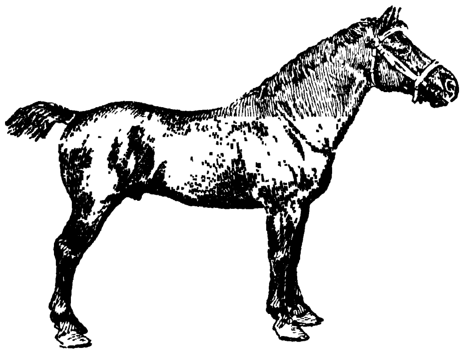


Fig. 485. Hackney-Welsh pony. Montgomery George, thirteen hands.

of Scotland are but a cross between the Shetland and a Welsh or some other pony. Many of the larger ponies of Scotland resemble much the Welsh cob. In times past a pony was often referred to as a Galloway. In fact, to this day the name is often seen.

The Galloway pony.—The Galloway, so-called from the part of Scotland known by that name, was once very popular. Youatt, in his second edition, 1846, describes it as thirteen to fourteen hands, sometimes more, bright bay or brown with black legs and small head. As the size was not considered

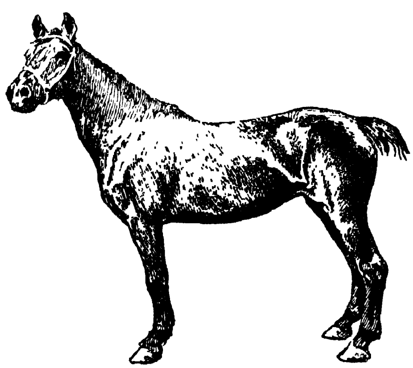


Fig. 486. Hackney pony mare. Mayflower, thirteen hands, three inches.

desirable, it was crossed with larger breeds, until now the original Galloway has entirely disappeared.

The Connemara, or pony of Ireland.

The Connemara, or pony of Ireland, is found chiefly in the County Galway, Ireland. It is an extremely wiry pony, showing a great deal of the Barb or Arab blood. It stands twelve to fourteen hands in height, sometimes more. Like other breeds that run practically wild in a hilly country, it is hardy, active and sure-footed. It has a thick and shaggy coat in response to the climatic condition of its habitat. In color, it is black, brown or bay and sometimes chestnut, betraying its descent. Often individuals are pacers. Since the middle of last century it has been allowed to deteriorate, but for some years past systematic endeavors to improve the breed by introduction of Thoroughbred and Hackney pony stallions have been in progress.

THE CELTIC, OR PONY OF ICELAND.

The Celtic or pony of Iceland, the Hebrides, north of Ireland, and the Faroes, is a small-headed pony with prominent eyes, slender limbs and small joints. A typical Celtic pony is generally of yellowish dun color, with a dark dorsal band and with some indication of stripes on the shoulders and in the region of the knees and hocks. These ponies have a close resemblance to the Scandinavian pony, and it is probable that they have a common origin. The Shetland, Welsh, New Forest and other ponies of the British Isles probably have a certain amount of Celtic blood, as ponies are frequently found of the former breeds with strong characteristics of the Celtic pony.

The ponies of the Hebrides, the Faroes and the north of Ireland are little known in this country, but the Iceland ponies are sometimes imported into America, although few are bred here. They are strong, sturdy, useful little animals, rarely exceeding thirteen hands, often reaching only eleven and one-half or twelve hands. They are used for light driving purposes and as children's ponies, and in England often as pit ponies.

THE ARABIAN PONY.

[The Arab pony is the Arab horse under the given height. For full discussion, see *Arab horse*, pages 446–449].

THE RUSSIAN PONY.

Russian ponies are traceable to eastern origin. They are hardy, serviceable and often of beautiful appearance. They rarely exceed fourteen hands in height, many being but twelve to thirteen hands. They are not common in America, but they are often seen in England, where they are used for light driving purposes or in the pits. In Russia, they are used for trade purposes and many of the cavalry mounts are but ponies. They have great endurance, and the best of them are not surpassed in usefulness by any other breed.

THE SCANDINAVIAN OR NORWEGIAN PONY.

The Scandinavian pony is closely allied to the Russian, and is evidently of the same origin. Not only have these ponies worked up through Russia to Norway and Sweden, but in the old days of the Vikings there is little doubt that many fine specimens of the Arabian were introduced into the country. Like the Russian, the Norwegian pony is practically unknown in America, but many of them are imported into England where they are used

generally for light driving purposes or in the pits, some being used as polo ponies.

MISCELLANEOUS PONIES.

The *Mongolian*, *Japanese*, *Korean*, *Burma* and *Manipura*, *Sumatra* and *Java* ponies can be of little interest to American breeders. In common with all ponies they have to a greater or lesser extent the hardiness, endurance, sound feet and legs that are the inheritance of a half-wild existence under adverse conditions. These ponies are exceedingly rare in America, and we have many types much superior in conformation and other desirable qualities nearer home from which to breed.

Literature.

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Saddle Horse, American. Fig. 487.

By *David Castleman.*

The American saddle horse, as its name indicates, is a saddle horse developed in America. While it is adapted first of all for saddle purposes, it has long since demonstrated its worth for light harness purposes. Its peculiar grace of motion and aptitude for the saddle gaits in their perfection, place it in the fore-front of horses used for saddle purposes.

Description.

The most outstanding characteristics of the American saddle horse are courage, docility and superb finish. His courage and spirit, coupled with his docility, give him his special usefulness on the battle-field, as well as in the harness. Breeders of this horse have held before them an ideal type, and it is not too much to say that this ideal has been approached somewhat closely. The ideal American saddle horse may be described thus: The nozzle is small and delicate, with distended and sensitive nostril. The head is bony, rather small, with generally just an indication of a dish in the face; the eyes full, round and prominent, and set wide apart. The small, pointed ears are set well apart, and are constantly played; sometimes there is a slight cup to the point of the ear. The horse should bear an expression of courage and gentleness. Behind the ears is the fine muscular throttle, on which the head is set at a good angle. The neck is long and gracefully crested. The shoulders are sloping. There is good depth through the heart, a short, strong back, the barrel ribbed well back and quite as large around the last rib as at the girth. The horse is strong across the kidneys and the coupling is powerful. The quarters are level, strongly muscled and long from the point of the hip to the hock. The tail comes out well up, is carried high, and is heavy, long and flowing. The body is set on comparatively short legs. The bone of the leg is broad, flat and closely knit, and the tendons strong. The fore-arm is powerfully muscled and the fore-legs straight. The hind-leg is not so straight as in the Thoroughbred, and is well muscled. The legs are short from knee and hock to ankle. The pasterns are a little long and sloping. The feet are hard but elastic, heels well spread and well developed. The average height of the saddle horse is about fifteen hands two inches, and the weight approximately 1,000 pounds.

History.

The American saddle horse is the outgrowth of necessity. Before railroads were established in this country, and while traffic was by horseback over unbroken or almost impassable roads, there was a demand for a sure-footed, sturdy horse that could travel long distances at a steady rate of speed, and at the same time carry a pack or a rider. Out of this need grew the American saddle horse, very crude and undeveloped at first, but to be gradually molded, as necessity changed, into the magnificent type as he stands today.

Virginia and the south Atlantic states had given much attention to racing, and at a very early date were breeders of the Thoroughbred. One source of importation was Canada. There they had raised a hardy little horse, said to be a cross of the French importations, generally with such stallions as could be secured from New York and New England. Incidentally, these stallions were most often of German and Netherland breeding. The Canadians had given much attention to the development of the pace or amble. Many of these Canadian horses drifted down into what were then the horse-breeding colonies. They had something of the gait and stamina required, but lacked in both beauty and courage. Some of these Canadian mares were crossed with available Thoroughbred stallions to produce a saddle horse, with most satisfactory results, certain lines of Thoroughbred blood giving the best product. The most satisfactory lines of the Thoroughbred blood were selected, and all others rejected.

The majority of the horses brought to Kentucky by the early settlers were these "saddlers," and many of them the best that had been produced in the older states. The natural character of the Kentucky country led to the concentration of the best of these new saddle horses within her borders. The importance that attached to the efforts of the

saddle-horse breeders in Kentucky, led to the name "Kentucky saddle horse" being applied to these horses.

Imp. Hedgeford was a brown colt, foaled in England in 1825 by Filho-de-Puta, out of Miss Craigie by Orville. He was bred by a Mr. Mylton, imported in 1832 by William Jackson of New York, and taken to Kentucky, where he died in 1840. Among his get was the great Denmark, which was foaled in 1839, out of Betsey Harrison by Aratus, and bred by Samuel Davenport of Kentucky. He was a game and consistent four-mile race horse, but not remarkable for his speed. Denmark was bred to the Stevenson mare 43, a brown saddle mare by Cockspur, the latter a saddler of one-half or three-fourths Thoroughbred blood. In 1850, Gaines' Denmark 61 was foaled, out of the Stevenson mare. He was the greatest of the sons of Denmark. He served through the Civil war, along with John Dillard, another famous saddler. Nine-tenths of the successful modern sires trace directly to Gaines' Denmark. Following the war there came a craze for speed horses, and many of the best saddle mares were stinted to trotting stallions, much to the detriment of the saddle horse.

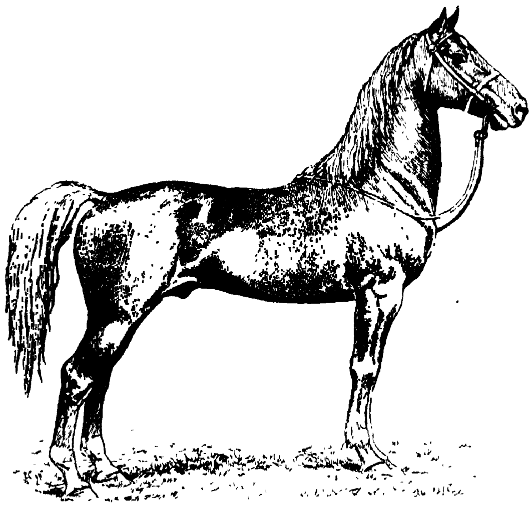

Fig. 487. A representative American saddle horse.

In 1891, the American Saddle Horse Breeders' Association was organized. In its studbook were inserted the names of the "foundation stock." In most of these foundation stallions there was a strong admixture of Thoroughbred blood, and many of them trace their lineage through Denmark's dam. In 1901, after ten years of careful work, the list of foundation stallions was revised to include the following ten horses: Denmark, John Dillard, Tom Hal, Cabell's Lexington, Coleman's Eureka, Van Meter's Waxy, Stump-the-dealer, Peter's Halcorn, Davy Crockett and Pat Cleburne.

John Dillard was by Canada Chief out of Lady Jackson, which was a daughter of Blackburn's Whip, which was by Imp Whip, and he was by Imp Saltram. Imp Saltram got the Saltram mare, and she was the dam of Jenny Cockracy, which produced Betsey Harrison, the dam of Denmark; Jenny Cockracy also produced Susette, the dam of Berthune, the sire of Van Meter's Waxy, another of the foundation list. This illustrates the constant interweaving of the same Thoroughbred blood that characterized the early breeding efforts. The same intricate inter-relationship could be traced for the other foundation stallions if space permitted.

Tom Hal was a Canadian pacer imported to Kentucky. He was a blue roan, foaled in 1802, and lived to the great age of forty-one years. He was the founder of the Hal family of Tennessee, of the Blue Bull family of Indiana and the noted Tom Hal saddle horses of Kentucky. Among many others, he was the sire of the noted horse Bald Stockings 76, which was the first horse ever noticed to go the running-walk. The dam of Cabell's Lexington was by Tom Hal. Here we catch genuine Morgan blood, for Cabell's Lexington was by Gist's Black Hawk, which was by Blood's Black Hawk, which was by Vermont Black Hawk. In Coleman's Eureka we again find Morgan blood on the sire's side and Thoroughbred blood on the dam's. He was a dark chestnut, sixteen hands high, and won about one hundred and twenty-five premiums in saddle and combined rings. Van Meter's Waxy was unquestionably a Thoroughbred horse. On the sire's side he traces to the two Barb horses sent to Thomas Jefferson by the Bey of Tunis. Stump-the-dealer was a Thoroughbred, tracing on the sire's side to Saltram and on the dam's side to Imp Diomed. He was a famous race horse. The Halcorn strain is recognized as a separate and distinct saddle family. Peter's Halcorn, the head of the family, is described as a remarkably handsome bay stallion. Of the breeding of Davy Crockett we know nothing. He was imported to Kentucky from Canada and has been a great producer of saddle horses. He was characterized by power and endurance, and had large, yellow eyes which he frequently imparted to his get. Pat Cleburne is noteworthy for his production in the hands of Missouri breeders.

This list might be greatly extended by the addition of the noted horses of more recent years. Mention should be made especially of the famous sires Black Squirrel 58, Montrose 106, Black Eagle 74, Chester Dare 10, Highland Denmark 730, Cecil Palmer 933, Bourbon Chief 976 and Dominor 2631.

Distribution.

The state of Kentucky justly claims to have been the nursery of the two American breeds of horses,—the American saddle horse and the Standard-bred trotter, although Tennessee, and more recently Missouri and Illinois, have been very instrumental in their development. The saddle horse has become distributed over most of the United States and parts of Canada. There are at least two very creditable studs in Canada and one in Mexico. Seven stallions have been sent to South America, two stallions to Porto Rico, five stallions to Cuba, one stallion to Hawaii, one to New Zealand and five to Japan. Three mares have been sent to England. It is

probable that representatives of this breed have also reached other countries.

Breeding.

But little can be said on this subject that is not applicable to all pure-bred stock. The one endeavor since the foundation of the type has been to produce a horse fitted in conformation and motion and intelligence for a definite purpose; to breed a beautiful horse, with as nearly perfect motion as possible. To this end, breeders have bent their energies in using the process of selection and rejection. Out of the years that have passed, certain lessons have been learned. The remarkable prepotency of the blood of Gaines' Denmark 61, in the male line, has been conclusively demonstrated. He is a reckless man who undertakes to produce the modern American saddle horse, with a stallion heading his stud which lacks the direct male trace to this greatest of the Denmarks. Fortunately, his blood has been so diffused that there is no danger of inbreeding. The years have also demonstrated that certain lines of blood have produced great brood-mare families. The daughters of Peavine 85, Dave Alsin 775, Harrison Chief 1606, Indian Chief 1718, and that exquisite son of Magic, Beauty 604, have produced very successfully when mated to stallions possessing a direct male lineage to Gaines' Denmark 61. Not yet has the Chief family produced an acceptable sire.

The general rules followed in the production of the present-day American saddle horse may be stated thus: (1) Have the stallion trace directly to Gaines' Denmark 61. (2) Have in the brood-mares as many crosses as possible of the proved great brood-mare sires. (3) Line-breed to the proved great brood-mares of the breed, and remember that of these, Nannie Garrett 472 stands easily first.

It seems hardly necessary to add that the question of individuality is even more pertinent here than in other breeds. No horse of this breed can carry such superior blood lines as to warrant overlooking inferior individuality. The ideal must be definite and must be adhered to.

Feeding.

It has been learned from the breeders of Thoroughbreds that the essential growth of a horse is mainly in the first year of his life. Hence, we antedate his birth and keep his dam in prime condition. For twenty-four hours after his birth, the dam has no food, but a bucket of water with the chill taken off is kept constantly before her. At the expiration of the twenty-four hours, the attendant should begin to feed both foal and dam. By the time the foal is seven days old, he and his dam are on full feed. When it is available, this feed consists of one-third wheat bran and two-thirds rolled oats. This, with either timothy or Burt oats hay, makes a well-balanced ration for mare and foal. This feed is placed in a trough low enough for the foal to reach and eat with his dam. By the time he is three days old, he will have learned to eat, and then he must be fed regularly. Whatever food is available for the mare and foal, it should contain a liberal proportion of protein.

It may be admissable for the writer here to give a warning, even though it may seem to be unnecessary. Both alfalfa and clover are dangerous if fed to breeding animals. This statement is made out of personal experience in breeding this horse. There is no better roughage for growing horses than clover hay. Alfalfa hay will do for horses if clover is not available, but its strong diuretic effect makes it necessary to watch it carefully.

The saddle horse in motion.

The methods of educating the saddle horse would carry us too far afield, but we may consider the motion of the educated horse. Beautiful as this horse is, he must be seen in motion to be appreciated. [For further notes on gaits, see pages 423, 424 and 427.]

The flat-footed walk should be prompt, brisk, elastic, "dead in line" and fast. Speed is important and should be equal to at least three and a half miles an hour. Horses will occasionally be found that will walk at the rate of four and a half miles an hour, but the lower estimate is good walking. It may generally be assumed that a horse is walking properly if all four shoes may be seen from behind him, and the feet on the same side are in line.

The trot should be true, "dead in line," well under the horse, balanced, prompt, and with both shoulder and stifle put well into the motion. Unless the shoulder is put well into the motion, the mere play of knees yields a racking, uncomfortable ride. Unless the stifle is brought into full play, the recovery is necessarily slow. This is not only a bad fault, but gives one an idea that the horse is going one gait in front, and another behind. To use a trade expression, "the horse is going in two pieces." For a comfortable ride, knee and hock action must be equal; and, given this equality, it cannot be too high. With all this, the ideal saddle horse must accomplish one more thing with his trot: he must trot with all four legs under him—the trot must be gathered; he must come up into the bit, and still not pull an ounce. The trot of the ordinary horse is straggly and too much extended. The men who best accomplish this "gathering" of the trot are the most successful educators.

The canter.—This gait, in its modern development, is a thing of beauty. The old "'lope" or gallop, which seemed to ride one down hill, is relegated with the side-swiping pace. The canter of today is high, bounding, elastic, gathered slow, and right under the horse. At this gait a horse's hocks should be right under him, the motion should come almost entirely from the front, while the quarters are sparingly used. The horse should lead with either foot, and change lead at command with such ease that no signal can be detected. His quarters should be so thoroughly flexed that they are always turned toward the center of the circle in which he may be supposed to be cantering. That is, when the horse is leading with the right foot his quarters should be well under him, and in to the right. In other

words, the horse's body should take the curve of the circle in which he is supposed to be cantering. This is the only possible way to get a comfortable and pleasing canter. At the same time, the rider should gently raise the horse, with an almost imperceptible pressure on the bit, at each upward bound. This is the canter in contradistinction to the gallop, and the American saddle horse seems almost to do it naturally.

The slow gait may be any one of three, that is, (1) the running-walk; (2) the fox-trot; (3) the stepping-pace.

(1) *The running-walk.*—This is the intermediate development between the flat-footed walk and the rack. The motion, rhythm and recovery are identically the same. It is a "single-foot," just as are the flat-footed walk and the rack. But the tempo is greater than in the walk, and less than in the rack. It is much the most graceful of the slow gaits, and the easiest on both horse and rider. At this gait a horse can cover mile after mile, up and down hill, without distressing either himself or his rider. A speed of six to eight miles an hour is not unusual, and occasionally a "running-walker," is found that can do nine miles or better. Not all members of this breed can be taught to go the running-walk well, and for that reason it has been decreed that either the fox-trot or the stepping-pace may be accepted as a substitute.

(2) *The fox-trot.*—This may be best designated as a mongrel gait. It is not so graceful nor so easy as either the running-walk or the stepping-pace. At this gait, the horse goes a jog-trot in front and paces behind.

(3) *The stepping-pace* is nearly as graceful a gait as the running-walk, and when well done is quite as easy on the rider and only slightly harder on the horse. It is not the side-swiping pace of the harness horse. At this gait the horse is going the running-walk with his fore-feet and pacing with his hind-feet.

The rack.—This gait is the highest development of the flat-footed walk. It is nothing but the flat-footed walk developed to high speed. The rhythm and motion are identical, and the old name of "single-foot" was an aptly descriptive term. The feet hit the ground in succession, one at a time. It is the flashiest and most attractive gait a horse can go, and while tiring to the horse, there is no gait more delightful to the rider.

Uses.

As a cavalry horse.—In both the Civil and Spanish-American wars the American saddle horse has been put to the test, and in both cases the testimony has been to his unsurpassed excellence as a cavalry horse. His endurance, combined with his smooth, fast walk, enable him to stand the hard strains with the minimum of fatigue to himself and his rider. He is reliable on the field and quick to adapt himself to the maneuvers.

As a commercial horse.—The same qualities that adapt the American saddle horse for cavalry purposes make him valuable commercially wherever horses are kept under the saddle. His winnings in the show-ring attest his popularity. In the ten years, 1896–1905, at the national horse show in Madison Square Garden, New York City, the American saddle horse won twelve out of a total of eighteen championships open to all breeds of horses that wear the saddle. His show-ring winnings add to his commercial value. Within a recent year, the following sales were made: The Moor, a three-year-old stallion, was sold for $7,500; Tattersall and Mate, a pair of geldings, sold for $6,000; Eugenia and Magna, a pair of mares, brought $5,000; American Girl, a four-year-old mare, sold for $5,000. Prices up to $1,000 for a single horse are not uncommon.

As a gaited horse.—The demand for gaited horses is met by members of this breed. Saddle horses of other breeds do the three natural gaits, the walk trot and canter. The American saddle horse is distinctive in that he can be readily taught to go the five gaits, the walk, trot, canter, rack or single-foot, and the running-walk, fox-trot or slow pace. The gaits are largely a matter of training with any horse, but the American saddle horse may be said to have an inherent tendency and aptitude to master the gaits more quickly and perfectly than horses of other breeds.

As a harness horse.—The American saddle horse has also a place as a light harness horse, as is indicated by the following examples: Emily 855, World's Fair Champion at Chicago in 1893, has frequently gone a mile in 2:35 to 2:50. Hitched double with Dorothy 1210 (winner of seventy-two blue ribbons in succession), the pair have driven a mile in 2:52. Rex Arbuckle 1467, champion light harness horse at the Kentucky State Fair in 1906, has driven a mile many times in better than a "forty" gait. This same stallion has won prizes in many five-gaited rings. Among others, John Dillard F. S. should be mentioned as a notable sire of the dams of light harness racers.

As a hunter.—Many of these American saddle horses have been educated as hunters. A notable example was Copeland 1153, whose name was changed to Pisgah. This horse won many ribbons in hunter rings.

Organizations and records.

The organization devoted to the interests of this breed is the American Saddle Horse Breeders' Association, with headquarters at Louisville, Kentucky. When this organization was first effected, in 1891, it had the name National Saddle Horse Breeders' Association. The change was made to the present name in 1899. The Association has published six volumes of its register, containing 6,327 horses. It has on its files at the present time additional registrations sufficient to bring the total number of registered animals up to a little more than 8,500. At this writing, the Association is engaged in a revision of its register.

Literature.

Literature relating to the training of horses, that may be of interest, is cited on page 424. [For further references, see page 416.]

Shire Horse. Figs. 41, 488, 489.

By *John A. Craig.*

The Shire horse is recognized as one of the leading breeds of draft horses. The best type is specially adapted for breeding the heaviest class of draft horses, suited for slow work, when weight and strength are prime essentials. For hauling large loads on lorries through crowded city streets, without jerking but steadily progressing, weight and strength are the main factors, and it is because of the possession of these qualities that the Shire maintains its position as a draft horse. A medium-weight horse may succeed in pulling more than one of heavier weight if permitted to rush at it; but to start a load steadily and keep it moving slowly, and repeating this frequently, as must be done on crowded streets, weight must supplement strength. Herein lies the reason for the popularity of the Shire for drayage purposes in England, where it originated.

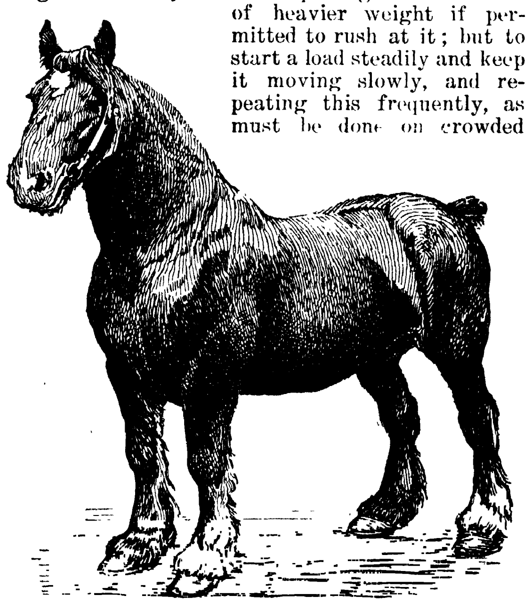

Fig. 488. First prize aged Shire stallion. Arrowside Duke. International Live-stock Exposition, 1906.

Description.

In general characters, this breed is very like the Clydesdale, being, perhaps, a little shorter in the legs, and slightly larger. The common colors are bay, brown or black, with white markings on the face and on the legs below the knees and hocks. Other colors are found but are not common. In conformation, the Shire is generally low, broad and stout, being heavy in build and slow in movement. The shoulder is likely to be too straight, making the action in front short and stilted, although it is generally considered that more power in the collar compensates for the deficiency in action. The body of the typical Shire is of large girth, deep and strongly coupled, with broad back. The quarters are heavily muscled in the best type. Owing to their weight, it is to be expected that some of them are subject to the criticism of being deficient in quality and too sluggish in temperament. In general, they may be considered to be of heavier weight than the Clydesdale, although the difference is not likely to be great between representative animals, as the following weights and measurements of two prize-winners will indicate: Vulcan (4145), a Shire stallion that was champion at the London Shire Show, in 1889 and 1891, when eight years old weighed 2,240 pounds in show condition; height, 17 hands; girth, 8 feet 7 inches; around fore-arm, 2 feet 7 inches; around bone below knee, 12 inches. Flashwood (3604), a Clydesdale stallion that was first at the Glasgow Spring Stallion Show, in the same years and months that Vulcan was first-prize stallion at the London show, and at the same age (eight years), weighed 2,240 pounds; height, 17 hands; girth, 8 feet; around fore-arm, 20 inches; around bone below knee, 11 inches; above hock, $21\frac{1}{2}$ inches; and below hock, $12\frac{1}{2}$ inches. In the best types the legs are strong, bone flat with a "feather" of fine hair on the rear of the cannons, below the knees and hocks. The feet are large and somewhat flatter at the heel than is desired.

History.

The Shire is considered to be descended from the old war horse of Great Britain and has been referred to as the War horse and the Great horse in Great Britain. It is reported of Cæsar, that when he invaded Great Britain, 55 B. C., he was impressed with the excellence of the horses that were attached to the war chariots of the Britons. The breed attained its greatest development in the lowlands of England, in Lincolnshire and Cambridgeshire especially. Other nearby counties contributed more or less to the development of the breed. In early times, heavy active horses were in greatest demand for war purposes, and this led to the importation of heavy horses from Flanders and Normandy. Large importations of the heavy Black horses of Flanders were made as early as the eleventh century, and in succeeding years in the reigns of King John, Edward II, and Henry VIII. One of the early improvers of the Shire was Robert Bakewell, who introduced blood of imported Holland mares in his breeding efforts. The development of the breed received much impetus in 1878, when the English Cart Horse Society was formed. The name of the society was due to the fact that the Shire was known primarily as a cart horse.

The history of the Shire shows a slow but persistent development of an improved type through a great space of time. The improvement of action and quality have received most attention from the breeders, and the results, as shown in a modern Shire, have been marked.

In America.—The progress of the Shire in America has been substantial but yet not so rapid as might be expected, considering the decided merits of the breed. This, in a measure, has resulted from the dislike of the American trade for hairy-legged horses deficient in quality. It seems that hairy legs are more or less characteristic of all heavy breeds of horses reared in low countries, and they have been a breed characteristic of the Shire

since its inception. At a very early time the hair was very abundant, and the writer has seen some of the old-time Shires with even the lock of hair growing from the region of the knee in front, and other locks growing from near the point of the hock. Coarseness and unusual profusion of hair indicate too much grossness of organization, although a fine feather finishes a heavy-bodied horse at the ground in a way that is usually pleasing to the eye. The first Shires to come to America showed these characteristics to an extreme degree, and the prejudice of the American trade has not in any degree abated with time. The first importation to reach America was in 1836, and was made to London, Ontario, Canada. The first Shires to come to the United States were imported in 1853, and taken to Aurora, Ill. The importations since then have been mostly into the states of Illinois and Iowa, and at no time have been numerous, except, perhaps, between 1880 and 1890.

Distribution.

This breed enjoys much prominence in England, as indicated by its prominence in horse shows. From there it has spread into most other English-speaking countries. Germany, Australia and Argentina have made importations. In America, it is most popular in the north-central states.

Uses.

For draft.—Like the Clydesdale, the Shire is a heavy draft horse, slow-moving but sure and steady, and makes no claims for other uses, except for crossing on native draft stock and for improving other breeds with an injection of its blood.

For crossing.—The use of the Shire has been an important factor in improving our horse stock for draft purposes, as attested by the extent to which the best drafters of our modern markets have Shire blood on the maternal side. The Shire is credited with having produced the highest-priced gelding that has been sold by auction on the Chicago market, and many more of the best have traced to Shire blood on the side of their dams. Dr. Alexander is authority for the statement that a grade Shire gelding, weighing 2,210 pounds, sold for $660 on the Chicago market in 1904, which is the highest price paid on that market that has been reported. Our breeding stock have surely not suffered because of the use of Shire blood, and there is a feeling that if the Shire had been more liberally used our breeding mares would more surely produce the highest-selling class of drafters. It remains to be said that the use of the Shire in our draft-breeding to such a limited extent may be due in a measure to the fact that the source of supply for importation is not so large as that of some of the other continental breeds; and furthermore, it is a difficult matter to induce the home-breeders to part with their very best types, so much desired in their native land for breeding purposes.

Organizations and records.

The first organization to care for the interests of this breed in England was the English Cart Horse Society, organized in 1878. Six years later it changed its name to the Shire Horse Society. It undertook the publication of a studbook, of which twenty-nine volumes have appeared. The American Shire Horse Association, with headquarters at Wenona, Ill., was established in 1885.

Literature.

Sir Walter Gilbey, The Great Horse: the Shire, London (1899); same, The Old English War Horse, London (1888). [For further references, see page 416.]

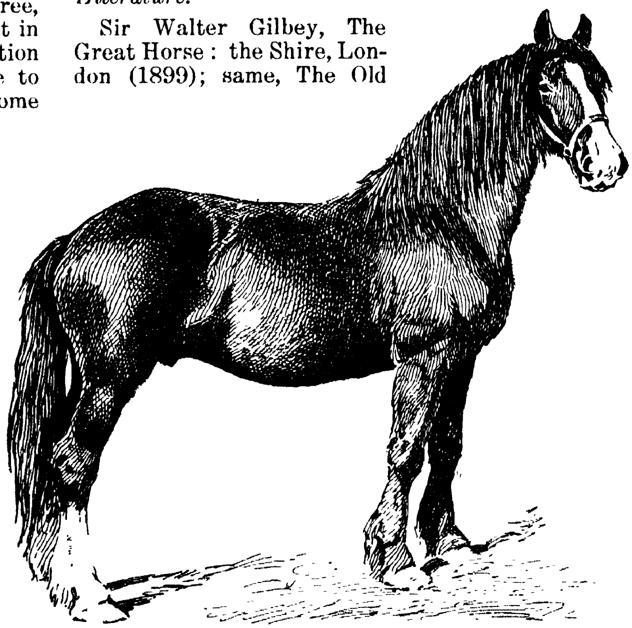

Fig. 489. A Shire colt.

Suffolk or Suffolk Punch Horse. Figs. 490, 491.

By *John A. Craig.*

This breed of draft horses has not become so widely known as other European breeds, such as the Clydesdale or Percheron. It cannot be said to be as popular as either of these two breeds, yet it has many ardent admirers. It is bred in greatest numbers in its native district of Suffolk county, in the eastern part of England. It gets its name from the county and from the round, full-made type of body that characterizes the breed.

Description.

The Suffolk is about sixteen and one-half hands high, and weighs about two thousand pounds. The color is exceptionally uniform, and it is generally some shade of chestnut. Breeders have long adhered closely to a chestnut color. In general type, it is a low-set, short-legged, deep-bodied, muscular horse, with clean bone and durable feet. The feet were once much criticized because of their flatness and brittleness, but have undergone great improvement in these respects. The head is clean-

cut, with small ear, full forehead, and a more or less Roman nose. The neck is full, with a very strong crest, as a rule, in stallions. Too much thickness in the throat-latch sometimes results from undue coarseness of the neck. The shoulder shows good length and is of true draft form, not being too oblique. The chest is deep, wide and moulded with muscle. The body or barrel, one of the leading points of merit in the Suffolk, is deep, round-ribbed, and specially well let down on the hind flank. This undoubtedly contributes to the strength of the assertion that it is an easy keeper, and possessed of unusual endurance. The legs, devoid of long hair, are clean-cut, cordy and well muscled at the arms and thighs. The degree to which the Suffolk is muscled in the hind-quarters, and especially in the lower thighs, is one of the special features of the breed. Pulling contests at an early time were common among the adherents of the breed, and it is said that the ultimate outcome of these has been to develop the muscles of the thigh and the quarter much beyond what is commonly observed in the representatives of the draft breeds. The seeming lightness of limb, compared with the depth and weight of body, and fullness of neck, has, in many cases, given the Suffolk an appearance of being greatly lacking in the proper proportion of such parts. It is a free mover, and this, with its somewhat lighter weight, easy keeping and docile disposition, peculiarly adapts it for farm work, express-wagon work and drayage purposes, where a certain amount of weight may be sacrificed for activity and durability. Individually and, to a remarkable degree, collectively, the Suffolk is a superior model of the draft horse.

History.

The Suffolk can trace its history back to the dawning of the eighteenth century, and as early as 1851 it carried off most of the prizes for draft horses at the Royal Agricultural Society Show, at Windsor. At that time it had a distinct lead over other British draft breeds, but it seemed to be content with home popularity. Volume one of the Suffolk Studbook is an exceptionally elaborate and interesting compilation of the early history of the

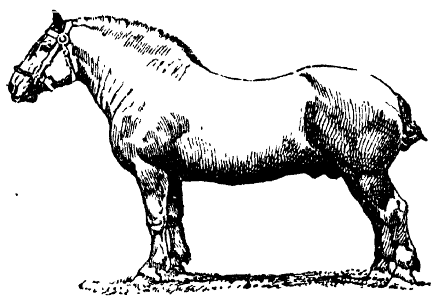

Fig. 490. Champion Suffolk stallion. Sudbourn Count (3257).

breed and should be consulted. Mention should be made here, however, of the so-called "foundation" horse of the breed—the Crisp horse, foaled in 1768, and owned by a man of that name residing in Sussex. His blood has been carefully preserved, and only horses that are traceable to him are eligible for registration in the Suffolk Studbook. Outside blood was introduced in an effort to im-

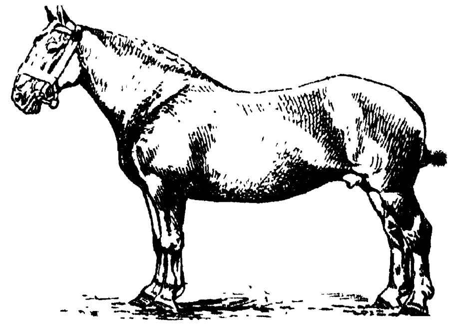

Fig. 491. Suffolk mare. Nectar (4177).

prove the Suffolk, but it had little effect. Docility, prolificacy and length of life characterize this breed. These horses have been much improved in the last thirty years.

In America.—Although it was first imported to the United States in 1880, by Powell Brothers, of Pennsylvania, yet the progress of the breed does not seem to be at all commensurate with its merit. The importations have been very slow and very small. In 1888, Peter Hopley & Co., of Iowa, and Galbraith Brothers, of Wisconsin, made importations, and these parties have since been the leading exponents of the breed in this country. A large importation is reported as having been made in 1903. Some other importations have been made since.

Distribution.

This breed has found favor in a number of countries aside from the United States and Canada, and is represented in Spain, France, Germany, Austria, Russia and Sweden on the continent, Australia, South and North Africa, New Zealand, Argentine Republic and other countries; and it has been the self-evident merit of the breed that has been the cause of this wide distribution. The breed has suffered, in America, particularly, because of the need of more freely distributed information regarding its good qualities.

Uses.

For draft.—The Suffolk ranks well as a medium draft horse because of its free action and endurance. As an agricultural horse and as an express-wagon horse, the Suffolk grade is superior, while those individuals that meet the requirements as to weight can hardly be improved for the heavier draft purposes.

For crossing.—The popularity of the Suffolk in this country has been held in check by the fact that it does not make so heavy a cross on the lighter native mares as the weightier representatives of the other draft breeds. Against this is the counter claim that it is very desirable for crossing on range mares, for the well-known even temper

and docility of the Suffolk is a valuable attribute to graft on to such parent stock.

Organizations and records.

The Suffolk Studbook Society is the publisher of the studbook for the breed in England. The first volume was published in 1880; and fifteen volumes have been issued to date. The breed is represented on this continent by the American Suffolk Horse Association, with headquarters at Janesville, Wisconsin. The first volume of the studbook of the latter association was published in 1907.

Literature.

For references, see page 416.

Thoroughbred Horse. Figs. 492–494.

By *Carl W. Gay.*

The term Thoroughbred, in its correct application, is restricted to designate the English race horse or runner, only. The incorrect use of the term, as synonymous with pure-bred, is so common as to lead to much confusion and misunderstanding. A "thoroughbred" trotter would be an anomaly and a "thoroughbred" Percheron impossible. When it is intended to indicate the total absence of alien blood, pure-bred is the proper adjective. Thoroughbred is a noun.

There is no one best breed of horses, but because of a more general adaptability to a wider range of conditions and a consequent broader usefulness, or as marking some special achievement in the breeding art, we may justly assign to one breed more importance than to others. In consideration of the greater number of view points from which the Thoroughbred takes precedence over other breeds, one seems justified in proclaiming it the most important of all breeds of horses. Its right to superiority may be sustained on the basis of the following facts: It was the first breed improved and the one on which the principles of breeding have been most systematically practised; barring the Oriental, from which the Thoroughbred is derived, his is the purest lineage possessed by any breed, and for it the first studbook for the recording of pedigrees was established; Thoroughbred blood has been most freely drawn on in the improvement of other breeds and types in fact, there is scarcely a harness or saddle horse living today that does not owe its merit in a large measure to the Thoroughbred crosses in its ancestry; the Thoroughbred has been a most important means of indulging a love of sport on the turf and in the field for three centuries.

Description.

The Thoroughbred conforms, in fact, is the truest exponent of the long, lithe, rangy, deep, narrow, angular type consistent with speed, and which is in such striking contrast to the low, broad, compact, and massive form significant of power in the draft horse. When it is borne in mind that locomotion is accomplished by the alternate flexion and extension of the articulations in the limbs; that the propulsion of the mass is by means of the muscular power of the hind-quarters, while the weight is sustained chiefly by the supportive action of the fore-limbs; that an elongated, cordy muscle has a greater degree of contractility and consequently tends toward a greater length of stride and more rapidity of movement than the short, thick, bulky muscle essential to power rather than pace, the speed type which the Thoroughbred represents is better understood. It is possible, however, to enumerate certain characters that are more particularly and distinctly Thoroughbred than this type, which is more or less common to all speed horses. These characters are derived in part from the Oriental progenitors, while some may be regarded as strictly Thoroughbred in their origin. Most characteristic are the extreme refinement and clear definition of features, the small proportioned head and ear, the straight face line, the neat throttle, sloping shoulders, sharp withers, muscular quarters, and clean, hard, flat bone. These are associated with a low, pointing, close-to-the-ground way of going, which insures the greatest stride with the least effort. Then, in addition to a racy form, the Thoroughbred has a racy temperament, possessing a most highly organized nervous system. The characteristic "buck knees" are all too commonly noticeable in the Thoroughbred from the galloping yearling to the seasoned campaigner. Another objectionable feature frequently noticed in the breed is the tendency towards weediness, as it is termed, i. e., long legs and light body. The prevailing colors are bay, brown, and chestnut, with one or more white markings. The most important modification in type during the development of the Thoroughbred is an increase in stature, which Sir Walter Gilbey estimates to have been one hand two and one-half inches from the year 1700 to the year 1900, the average height of the modern Thoroughbred being fifteen hands, two and one-half inches. The average weight may be given as about one thousand pounds.

A detailed description of the Thoroughbred follows:—Weight, 900–1,050; height, fifteen to sixteen hands; color, bay, brown or chestnut, with more or less white in the face or on limbs; a very "breedy" head, with sharply defined features, a straight face line, trim muzzle, large nostril, full, clear, prominent eye, broad forehead, neat ear and clean-cut throttle; neck long and rather straight, giving a moderately low carriage of the head; shoulders sloping and well finished at the withers; strong back, loin and coupling, altogether making a short top-line compared to the length of the under-line, although having length sufficient to insure freedom of stride; a very deep fore-rib and chest, lung capacity being secured in this way rather than by thickness and fullness of chest; croup long and a bit straight; deep, full, muscular quarters and gaskins; clean, smooth joints; a broad, flat, bony leg of more quality than substance; oblique pasterns and a rather small foot of dense horn. A fine, smooth coat of hair with a total absence of any feather, and a soft, delicate skin with the superficial blood-vessels well marked,

complete a general appearance of quality and refinement.

History.

A knowledge of the early horse history of Great Britain is necessary for a complete understanding of the origin of the Thoroughbred. Three things are involved: the native foundation stock, the top crosses of foreign blood on this base, and the ideal in the minds of the breeders. It is interesting to note first, that there are no indications of any horses having been indigenous to Britain, although the most recent researches reported by Ridgeway indicate that horses of the north African type were in Ireland as early as the sixth century. The horses with which Britain was first stocked are generally held to have been derived from the pony types native to northern Europe, and consequently were small in stature. We know that the first efforts at improvement were in the way of increasing the size. The Norsemen were the first to introduce the war horse, and the blood of Normandy and Flanders was thereafter drawn on in an attempt to produce horses of a sufficient size and strength to carry an armored knight. Among other edicts enacted in the reign of Henry VIII, was one limiting the size of sires to be used to not less than fourteen hands.

The horse as a feature in the sports of the times is first mentioned in the latter half of the twelfth century, when races of a primitive character and mounted sports were conducted at Smithfield, as a recreation for the people. The first race reported was run between Richard II and the Earl of Arundel in 1377. Henry VIII was the first king who ran horses for his own amusement. In 1580, the horses of Great Britain were classified by Thomas Blundeville as follows: "a breed of Great Horses meete for warre and to serve in the field," "ambling horses of a meane stature for to journey and travel by the waie," "a race of swift runners to run for wagers or to gallop the buck and a breed only for draftes or burden." It is important to note that at this early time horses were extensively used for racing and hunting. They were undoubtedly the descendants of the Barbs and Turks, which are known to have been in Great Britain at an early date, the Arab not having been introduced until 1616. Racing increased in popularity under James I, who imported the first Arabian for the purpose of breeding horses of greater speed. After the example of James I, other and frequent importations of Arabians, Barbs, and Turks were made from the Orient and Spain. By the time of Charles I, the sentiment in favor of racing had become so strong that much concern was felt for the defense of the kingdom, as so little attention was then being paid to the production of the Great or War horse.

The real era of the Thoroughbred is usually dated from the time of Charles II (1660–1685). He not only took an active interest in racing, but imported direct from the Levant. His most notable importation was of the Barb mares, commonly known as the King's or Royal mares, which are regarded by some authorities as the foundation dams of the true blood horse. Others, however, doubt the accuracy of thus limiting the base of the breed.

The three most important Oriental sires in the foundation of the Thoroughbred were the Darley Arabian, now known to have been a pure-bred Anazeh, imported in 1706; the Byerly Turk, imported in 1689; and the Godolphin Barb, brought in 1724 from Paris, where he was found hauling a water-cart, having been discarded, no doubt, by some member of the royal family to whom he had been presented. Eclipse, the greatest horse of his kind, is a direct descendant four generations removed from the Darley Arabian, as

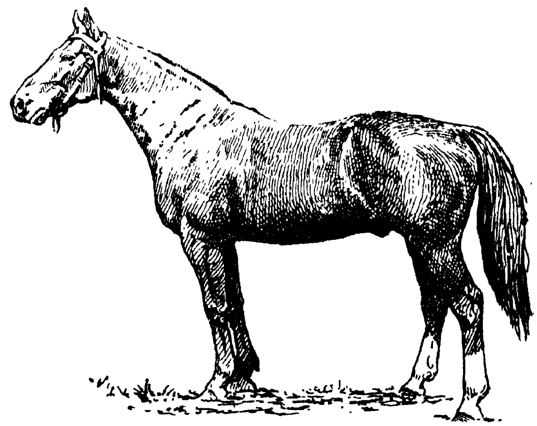

Fig. 492. Thoroughbred sire, Banastar. Winner of Brooklyn handicap, 1889.

were also Blaze, three generations removed, the foundation Hackney sire, and Imported Messenger, six generations removed, the foundation American trotter sire. From the Byerly Turk comes King Herod, another noted sire, while Matchem, a great race horse and successful sire, was a grandson of the Godolphin Barb. Furthermore, Justin Morgan, who shares honors with Imp. Messenger, already referred to as a foundation American sire, is said to be a direct descendant of Godolphin Barb. It is said that American Thoroughbreds, as a rule, are less remote from their Oriental ancestry than the average English horse, and that they follow more closely their type.

Thoroughbreds have been bred for nearly three centuries under a most rigid system of selection, turf performance being the standard. The high degree of equine perfection exemplified by the best Thoroughbred individuals, as well as the prominence to which the breed has attained, can be attributed in large part, no doubt, to the fact that the destiny of the Thoroughbred has been cast with men who had unlimited resources on which to draw. The Thoroughbred has been given every chance, but he has been tried out in most severe and diverse ways, and has triumphed.

Time and altered customs have wrought important changes in the system under which these horses are raced, with some corresponding modifi-

cation in type. Whereas, up to 1880 these races had been in four-mile heats, the custom now is to run dashes, carry less weight, and start as two-year-olds, a custom, which, like the horse, has come to us from England. The wisdom of the present course is doubted by some who hold the stamina

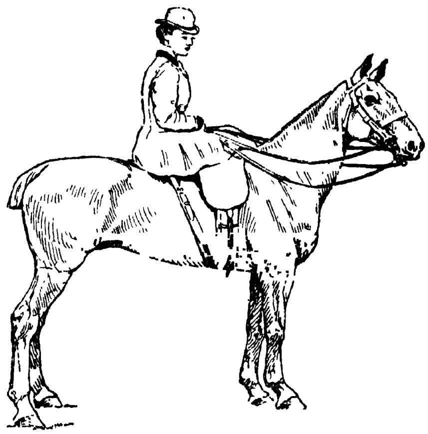

Fig. 493. Hunter type. Part-bred horse. Chappie Lee.

and weight-carrying ability of the old four-milers in higher esteem than the great flights of extreme speed for a few furlongs, shown by our modern sprinters. Conflicting opinions are expressed, too, with regard to the probability of these twentieth-century horses being capable of lowering the distance-records of a century ago. Those who know, however, are reluctant to admit that the Thoroughbred of today is a degenerate in any sense, and, in support of their view, they maintain that in olden times the horses ran but a few races a year, with no handicaps, and they were especially trained for each race. Against this, the modern horse is credited with being kept in racing form nine months in the year, running many races in a single season, and these closely contested because of the number of contestants and the method of adjusting handicaps.

The three classic events run in England are the Derby, the St. Leger, and the Oaks. The first Derby was run May 4, 1780, for a stake valued at fifty guineas, open to three-year-olds, colts to carry eight stone, fillies seven stone eleven pounds, over a distance of one mile. It was won by Diomed. The first and only American-bred horse to win the English Derby was Iroquois, a line descendant of Diomed, racing in the colors of Mr. Pierre Lorillard. This horse, the same season, won the St. Leger, a most notable feat in view of the fact that both Derby and St. Leger have been won by the same horse but nine times in over a century of racing.

In America.—It is natural that this country should have been the first, after England, to take up the Thoroughbred and sytematically breed and race him. It was not long after the colonization of the southern provinces by the English gentry that there was established an American turf with its Thoroughbred studs.

In connection with the introduction of the Thoroughbred into America, some mention of the so-called native horses should be made. While there is abundant evidence in the way of fossil remains of the presence and possibly the evolution of a prehistoric horse on the American continent, still there were no horses of any description found here by Columbus. He it was who on his second expedition made the first importation of which we have any record. These horses are thought by some to have perished soon after their arrival, while other authorities assert that they eventually gained the mainland and constitute a part of our foundation stock. Cortez, in his conquest of Mexico in 1519, is credited with having landed the first horses on American soil. In 1527, Cabeza de Vaca brought horses to St. Augustine, Florida, which were afterward liberated. Again, horses constituted a part of the equipment of De Soto's expedition in 1541, on which he discovered the Mississippi. Thus far these were all Spanish horses of Oriental extraction—the same original source from which the Thoroughbred sprang. In 1604, the French took horses into Nova Scotia, and four years later introduced them into Canada. Then followed the importation of one stallion and six mares into Virginia from England. Dutch horses arrived at New Netherlands in 1625, and in 1629 the first horse to inhabit New England arrived at Boston from England. As early as 1678, there ranged over parts of the Mississippi valley vast bands of wild horses, the descendants of those escaped or liberated from early conquests and expeditions.

In view of the character of the early settlers of Virginia, New York and New England, respectively, it is not strange that the cradle of the Thoroughbred in America should have been in Virginia. Horse-racing was not consistent with the Puritan traditions of New Englanders, and the Dutchman's horse in New York was essentially a beast of burden. It remained, therefore, for the cavaliers of Virginia, North Carolina and Maryland to become sponsors for this horse, which was later to play such an important part in American sporting and industrial progress.

The first race horse imported to America is thought to have been Bulle Rock, son of the Darley Arabian, brought into Virginia in 1730. The first racing organization of which we have record was formed in 1760 at Charleston, South Carolina. Subsequently there were brought over many of England's best horses, the most notable of which was Diomed, winner of the first English Derby. This horse, imported as a two-year old in 1799, by Colonel Hoomes, much against the advice of his counselors, is regarded as the real progenitor of the American race horse. In a regular line of descent from him come Sir Archy, the first truly American Thoroughbred; Boston, his grandson, conceded to have been the greatest American race horse; and, in turn, his son, Lexington, a scarcely less remarkable performer than Boston, and a most influential sire, especially through the female line, in the American trotting and saddle families, as well as of the Thoroughbred.

The trend of Thoroughbred sentiment was first northward from its original seat, about the middle of the eighteenth century, centering later about the Union course on Long Island, then westward into Kentucky and Tennessee, where the first race-course was established at Lexington, some time previous to the organization of a chartered association in 1828. The environment of Kentucky proved so congenial to the horses bred there that it soon attained its premier position among the horse-producing states. Then, in the natural course of events, some of the best blood of Virginia and Kentucky found its way into California, and there were soon founded studs which later achieved national fame. The Civil war proved a serious set-back to the breeding operations then well under way, but the Thoroughbred soon recovered from this interruption, and with the reëstablishment of affairs on a stable basis, became generally distributed throughout the length and breadth of the land. While he is still more extensively bred in those regions where he first came to his own, there is hardly a state at the present time, the general horse stock of which has not been benefited by this blood. Notable patrons of the Thoroughbred in America have been Washington, Jackson, Clay, Jefferson, and John Randolph.

The record, 1:35½ for one mile straightaway, was made over the Monmouth track, New Jersey, by Salvator, as a four-year-old, in 1890. The record price for a Thoroughbred is $187,500, paid for Flying Fox. The premier American sire of recent times is generally conceded to have been Hanover, owned by Milton Young, of Lexington, Kentucky.

Distribution.

The Thoroughbred has found its way into all countries where speed horses are popular. Other countries to follow the precedent of England in the establishment of the course and the patronage of the Thoroughbred, were America, France, Germany, Australia, and Argentina especially.

Part-bred horses.

In accord with the idea that the term Thoroughbred implies that a horse is totally of the blood, the term part-bred has become a common means of designating a horse that is not altogether, but only partly, of the blood. It is even customary further to indicate the proportion of hot or Thoroughbred blood, by applying the terms two-parts or half-bred to the get of a Thoroughbred sire out of a common bred mare, and three-parts or three-quarters bred to the individual whose sire was a Thoroughbred, while his dam was two-parts bred as above. In those sections of the country where Thoroughbred sires have been available, horses of this fractional breeding are common, and in view of the commendable movement of the American Jockey Club in establishing breeding-bureaus in the different states for the distribution of Thoroughbred sires, the part-bred horse may be expected to fill a still more prominent place in the future. As a matter of fact, horses produced in this way have such a wide field of usefulness as to keep them in steady demand; therefore this is a line of breeding that may be strongly commended to many farmers, who, with their present practice, have occasion to complain of the market. While these horses are produced principally as green hunter material, the part-bred horse is a most versatile equine. It is questionable whether there is any type of horse that can fill more acceptably so many different vocations as he. While somewhat deficient in style and trotting speed, his substance and stamina make him a stout, all-day road horse. He can be easily schooled to the walk-trot-canter standard, while his greatest accomplishment is to take up one hundred and eighty to two hundred pounds weight and carry it safely for long distances cross country at considerable speed, doing all the jumping requisite to such a performance. It has been further demonstrated that the part-bred horse has a place on the farm.

Uses.

For sporting purposes.—There may be some question as to the propriety of claiming any real usefulness for a horse, the only purpose of which is to serve as an active factor in the sports and pastimes of nations. Be that as it may, no one can deny to the Thoroughbred full meed of praise for a most efficient service in his own peculiar field. The turf, originally an English institution, was early transplanted to other countries, and all peoples among whom flat-racing, steeple-chasing, hunting, and polo are in vogue, may be expected to testify to the usefulness of the Thoroughbred.

Fig. 494. A Thoroughbred mare of the saddle type.
Champion Jasmine.

There is such diversity of opinion, even among authorities, as to the relative merits of the Thoroughbred and the American saddle horse for saddle work, and the Thoroughbred and the part-bred horse as hunters, that the fairest way to treat them would be a review of the evidence on both sides. By his opponents the Thoroughbred is objected to as a saddle horse because of his dis-

proportionate height at the withers and croup, his unsymmetrical appearance from the saddle, his low "daisy cutting" way of going, which they assert is conducive to stumbling, and his erratic nervous temperament, which renders him untractable under restraint. Opposed to these objectionable features are the spirit, the indomitable courage, speed and stamina, which are possessed by no other horse in the same degree. For riding to hounds the Thoroughbred is said by some to be ill-adapted because of his temperament, which makes him fretful at checks and difficult to control when running. Furthermore, the average Thoroughbred is not up to the weight imposed by many riders who care to indulge in this sport. On the other hand, his supporters maintain that his speed, stamina, courage, and nerve force may be relied on to bring one in safely at the death when others fail. It is said that he does not get "doppy" at his fences, but will jump, as well as run, on his courage when fatigued, and that altogether his performance is more in keeping with the sport than that of his colder-blooded contemporary. A logical conclusion seems to be that the Thoroughbred horse is best adapted to a thoroughbred rider. As stated by one authority, "Thoroughbreds are horsemen's horses," and one who understands their disposition and eccentricities is not likely to be satisfied with any other kind of a mount; while, for those less accomplished in horsemanship, and satisfied with a more moderate ride, the horse which has his fire cooled to some extent by a dip of plebeian blood is more suitable.

For crossing.—To estimate properly the full utility value of this race, it is necessary to consider, in addition to the service which individuals of the breed have rendered in performance on the flat and cross country, the great influence of the blood in union with that of other stocks. Notwithstanding the fact that this horse has been the creation of generations of sportsmen, with speed performance the standard of selection, it is the potency of his blood when blended with common, native stocks which is of greatest value in the production of market horses for use outside the realm of sport. In all but the draft breeds the influence of the Thoroughbred may be demonstrated. In the heavy-harness division, the foundation blood lines of the recognized breeds are significant. The Hackney descends from Shales, a son of Blaze, Thoroughbred, out of a strong common mare of Norfolk. Thoroughbred sires have produced from native French mares the half-blood horses from which the French coach has been evolved. They are still called Demi-Sang (half-blood) in France. The German coach horse has less of the Thoroughbred character and foundation, but even here "the trail of the blood" may be traced. The Yorkshire coach horse represents a Thoroughbred-Cleveland Bay cross. The representative light-harness horse is the American trotter, and the two individuals accredited with being the foundation sires are Imp. Messenger, Thoroughbred, and Justin Morgan, said to be of Thoroughbred extraction. The American saddle horse, as a breed, is descendant from Denmark, Thoroughbred, son of Imp. Hedgeford, and repeated infusions of Thoroughbred blood are still admitted. Furthermore, the ranks of the hunter, jumper, and polo pony classes, not breeds, but market types, are chiefly filled by either full- or part-bred blood horses.

Ailments.

It cannot be said that there are any diseases peculiar to Thoroughbreds, nor that they show a marked predisposition toward any of the affections to which all horses are heir. It is true the disease known as Osteoporosis, or, more commonly, "big-head," is frequently found in some of the large Thoroughbred breeding-studs. We have reason to think, however, that the disease is due rather to the conditions under which Thoroughbreds are especially likely to be kept than to the horse independent of those conditions. Thoroughbreds in training, especially youngsters, are prone to develop sore shins, which involve the fore-limbs in much the same manner that athletes are affected under similar conditions. The most common abnormality to which Thoroughbreds are subject is the peculiar attitude of the fore-legs termed "buck knees." In other horses, a similar condition results from hard road or track work, but in Thoroughbreds this standing over may be noticed in yearlings that have had practically no work. It is said by some trainers that colts which show this tendency will stand up under severe training better than those which stand straight on their fore-legs.

Organizations and records.

The first publication of recorded pedigrees and performances was in 1829. The official organ and record of the Thoroughbred in England is the General Studbook of Great Britain. In this country, Thoroughbreds are registered in the American Studbook for Thoroughbreds, the official organization being the American Jockey Club.

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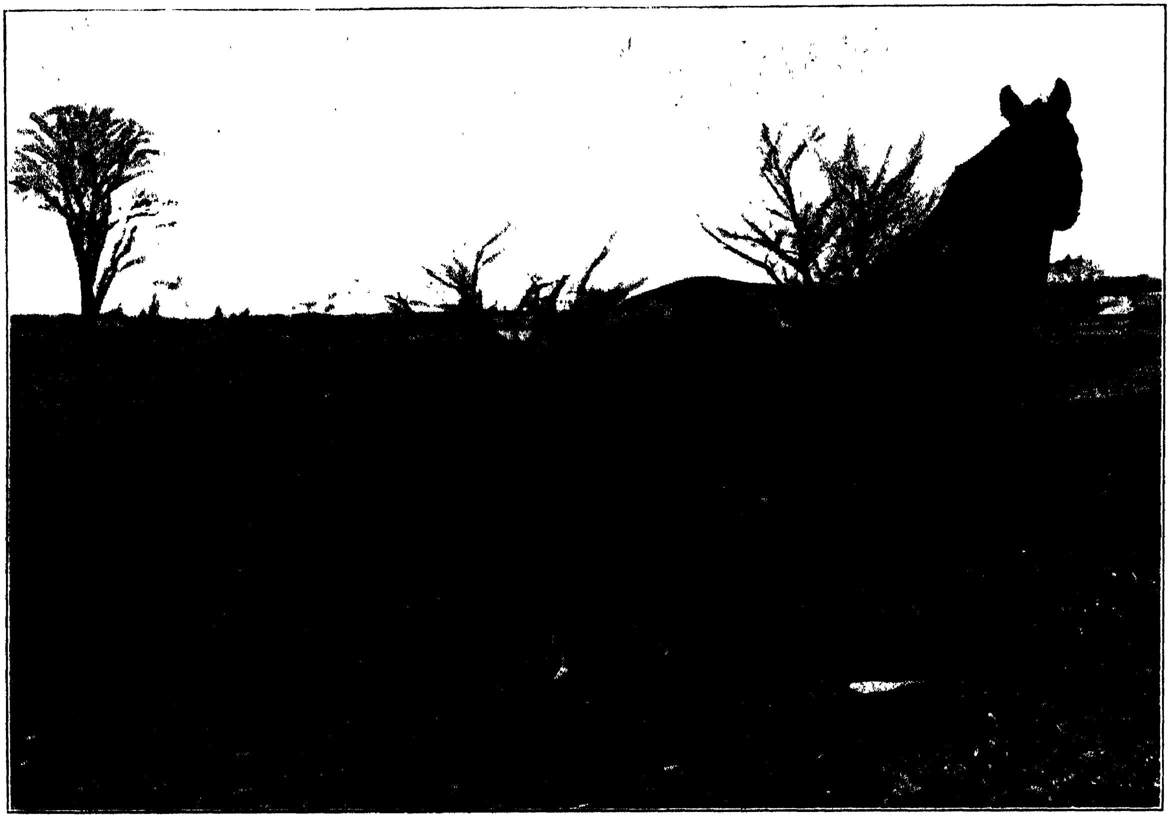
Trotting and Pacing Horse, American Standardbred. Figs. 44, 476, 495.

By *John A. Craig.*

The trotting horse has entered more largely into the pleasures and uses of the American people than any of the other classes of light horses, although the gaited saddle horse has been to some extent a competitor in these directions in recent years. For trotting purposes on the track or on the road, no other strain or breed has approached the American Standardbred trotter. Its development to the



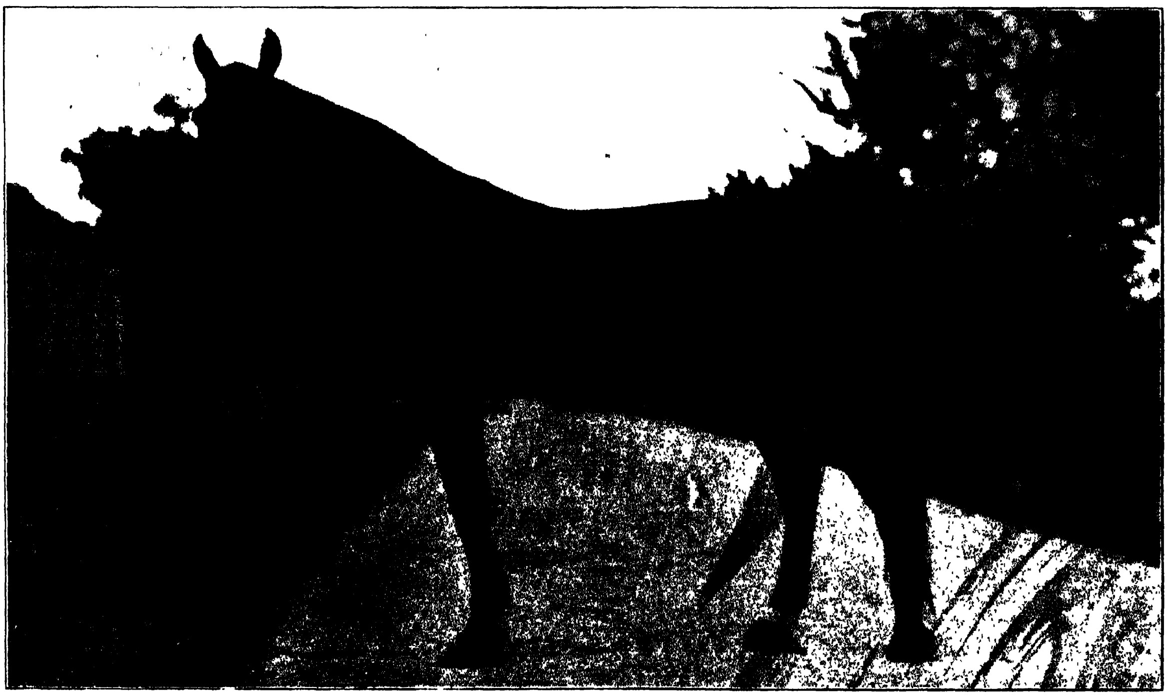


Plate XVII. Road and speed horses. Morgan above (a sire used in the government experiments in Vermont, in breeding Morgan horses; page 506). American trotter below

present excellence is due wholly to the work of the American breeder, although most of the original material that entered into the foundation of the American Standardbred trotting horse came from outside sources.

Description.

There are many pronounced types among the Standardbred trotting horses. Some are speed marvels, as Lou Dillon, slim, graceful and of high nervous organization; others are of the campaigner type, stronger-framed, fuller-muscled, of larger size, with controllable disposition, so as to be easily rated, and of remarkable strength and durability. Of such is Sweet Marie. The most successful blend of these two types is Cresceus (Fig. 495), both a speed marvel and a campaigner. A pen description of him would embody the attributes of the best type so far evolved. In general, such a horse should be about sixteen hands high, upstanding, well set up, and have that poise of body which horsemen refer to when they say a horse is "above himself," either standing or in action. The head, proportioned evenly with the other parts, is clean-cut and carried high. The neck has length and is muscular, making a noticeable crest in the stallion. The shoulder is deep, covered with muscle, and the chest is low and only moderately wide. The fore-leg is long from elbow to knee, and short from knee to fetlock. The knee is wide in front and sharp behind, and the tendon drops from there almost vertically to the pastern. The pasterns slope nicely, and the feet, both before and behind, are even in size, moderately large, and of a healthy, oily color. The back is well covered with muscle and is rounding, and the swelling muscles of the loin cause it to rise slightly; those of the hind-quarters make the croup plump and the quarters full and deep. The leg is long from hip point to hock, and short from there to the pastern. The web of the hock is thin and the leg below decidedly fluted. The action should be clean, quick and frictionless. Above all, the disposition should be easily controllable, and yet ever ready to race with zest. Good weights are 900 pounds for a mare and perhaps 1,150 pounds for a stallion. The color is not fixed, but brown and bay are very common.

History.

In common with all breeds of light horses, the American Standardbred horse (the writer uses the word "breed" advisedly, for he will show that our horses officially known under this name are as much entitled to it as any other) traces back through the Thoroughbred to the Arab. The Arab is the original source of the Thoroughbred, and nearly every breed of light horses worthy of note has drawn so largely on these two that it makes the Darley Arabian, the Byerly Turk and the Godolphin Barb the triune root of all of them. [See the articles on the Thoroughbred and the Barb and Turk.]

Previous to the advent of these Eastern importations, racing had not attracted much public patronage in Great Britain. A writer[1] refers to the time of their advent as follows: Byerly Turk, about 1689; Darley Arabian early in the eighteenth century; Godolphin Arabian (probably a Barb), 1728. Trotting matches seem then to have been unknown, but it was about that time that marked the era of running races. In 1751, Reginald Heber published the first number of the Racing Calendar, and the light horse-breeding interests of Great Britain began to assume noticeable proportions.

[1] Light Horses: Breeds and Management.

The Darley Arabian sired the first great Thoroughbred or running horse in Flying Childers.

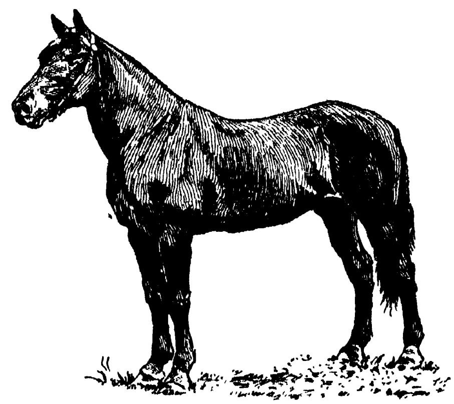
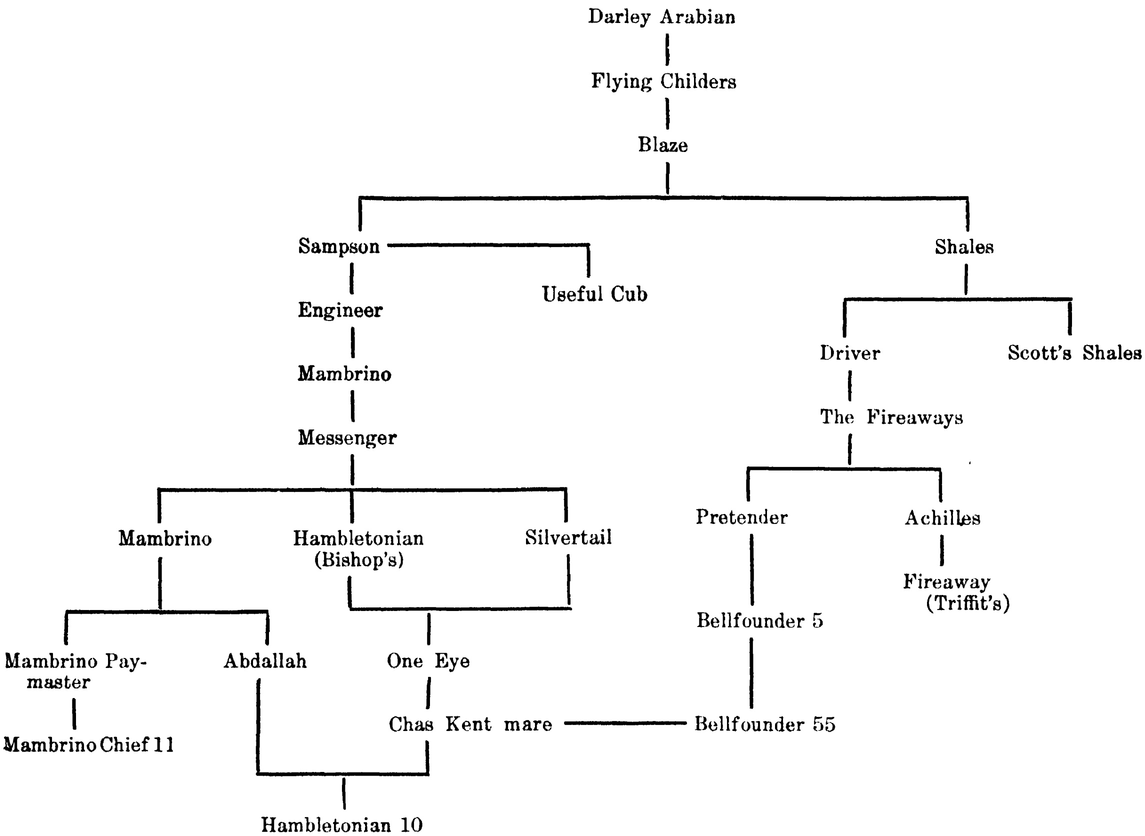


Fig. 495. American trotting horse. Cresceus, 2:02¼. Owned by W. W Savage.

While Flying Childers was a stout race horse, yet it was through his brother, Bartlett's Childers, progenitor of Eclipse, that the most turf performers trace. Flying Childers sired Blaze, foaled in 1733, whose pedigree is given very completely by Captain Urton (Newmarket and Arabia). This pedigree shows that Blaze was deeply bred in Oriental blood lines, and yet from him it seems a little stream of trotting blood emanates, which history pronounces to be the most ancient source of two modern breeds,—the American Standardbred horse and the Hackney. Perhaps the chief notoriety of Blaze in Thoroughbred circles was attained through his being the sire of the dam of Herod. He also had two sons of interest in this discussion, namely, Sampson and Shales. Sampson shows a derivation in type from other Thoroughbreds of the time, being considered a very large horse, 15.2 hands high, and said to be the largest-boned Thoroughbred horse ever bred. He was a noted and proved race horse. He sired Engineer, sire of Mambrino, sire of Messenger. He was also the grandsire of the dam of Useful Cub, that trotted seventeen miles in less than an hour. Shales, the other son of Blaze, sired Driver and Scott's Shales, both of which were trotters, and considered by careful investigators to be pillars of the Hackney.

Messenger was imported in 1788. His line is an unbroken series of trotters. He sired Mambrino, which had about a dozen trotting sons, in three of which we are chiefly interested: Mambrino, Bishop's Hambletonian and the mare Silvertail. Mambrino sired Mambrino Paymaster, and Abdallah, the

former the sire of Mambrino Chief, founder of the family of that name among Standardbred horses. Abdallah sired Hambletonian 10, the founder of the Hambletonian family in the Standardbred breed. Silvertail was the dam of One Eye, the dam of the Charles Kent mare; and this mare was by Imported Bellfounder, which traces back through the Fireaways to Driver, the son of Shales, the son of Blaze. To get all this clear, the following chart is submitted:



With the advent of Messenger, the trotting instinct becomes decidedly more pronounced. The chief feature of his pedigree is that he was not only a Thoroughbred, but dips deep into the fountain sources of that breed. The records are pregnant with the performances of his progeny and also attest to his value as a progenitor of trotting speed, through the get of his sons, and the degree to which their blood permeates the pedigrees of even our most notable of modern trotters. In the catalogue of the International Stock Food Farm, there appears an exceptionally erudite pedigree of Dan Patch 1:55¼, the champion pacer of the world, and it is shown that he traces forty-three times to Messenger. The first noted performer of this strain was Topgallant. Paul Pry, a grandson of Messenger, was ridden by Woodruff 18 miles in a fraction less than 57 minutes. Lady Suffolk began racing in public in 1838, and for fifteen years raced the most successful trotters of her time. The almost equally famous mare, Green Mountain Maid (not to be confused with the mare of the same name that was Electioneer's dam), and Princess, another notable campaigner, were of this blood. Happy Medium might also be said to be an inbred Messenger. When we consider that his daughter, Nancy Hanks, 2:04, was out of Nancy Lee by Dictator by Hambletonian 10, it is easy to understand how deeply bred this remarkable trotter of our day embodies Messenger blood.

Before taking up the influence of other Thoroughbred sources, there are other scattering streams of Messenger blood that should be mentioned. The Clay family, through the founder, Henry Clay, has a very distant infusion. The Morgan family, also, has a considerable infusion of Messenger blood. Among the old Canadian families having Messenger blood, one of the most prominent is that of Royal George 9. Royal George's descendants today bear out the fact that the Messenger family was the most prolific source of trotting speed in Canada. Another Canadian family that runs into some of our best Standardbreds originated in the Bullock horse, which traces directly to Messenger. Strathmore (408), the founder of one of the very best families of the

Standardbred trotter, carried much Messenger blood.

These references, showing the infusion of Messenger blood into the families of Mambrino Chief 11, Hambletonian 10, Morgan, Clay and others, will enable one to form some idea of the degree to which Messenger blood forms a widespread foundation for the present Standardbred trotter.

Other imported contributors.—Besides Messenger, several other imported Thoroughbreds have contributed to the breeding of the Standardbred trotter. Suffice it to mention Bonnie Scotland, Australian Trustee, Lapidist and Glencoe. The influence of these was chiefly through their American-bred sons and daughters.

Influence of American horses.—Let us now consider the status of the horses in use on this continent as road horses or trotters, about the time (1788) that Messenger was imported. In the earliest colonial days, most of the traveling was done on horseback, and a race most popular for journeying this way was the Narragansett pacer, bred most largely in Rhode Island. In addition, this pacer was the racing horse of the people of Rhode Island and Virginia as early as the last of the seventeenth century. Dr. McMonagle states: "The combination of these (Narragansett) with the French stock imported from France to Quebec, in 1665, produced the Canadian pacers. Out of that combination we have the Pilots, which were taken to Kentucky and proved to be the producers of some of the best trotting horses there. From the same stock we have the Columbuses, which were taken to Vermont, where they produced trotters of which the fastest went in 2:19¾—a daughter of Phil Sheridan, the most potent sire of the family." It seems clear to the above writer that the Narragansett pacer was largely the original source of the Canadian blood so largely taken to Kentucky and other states at an early day.

Justin Morgan, the founder of the family of that name, was foaled in 1793 (some authorities give it 1789), and Pilot, about the first to attract the attention of the American public, was foaled about 1826. The Pilots, St. Lawrences, St. Clairs, Columbuses and Copperbottoms were taken from Canada at the beginning of the last century to Vermont, New York, Kentucky, California and other states that were trotting-horse centers at that early day, and blended well with the other families that were forming. The Morgans were well under way at this era. The three sons that formed leading branches of the family were Sherman, foaled in 1809, Bulrush, foaled in 1812, and Woodbury, foaled in 1816. Then, too, the Bashaws and the Clays were starting under way; for Grand Bashaw was imported in 1820. He sired Andrew Jackson, foaled in 1827, which, in turn, sired Henry Clay and Long Island Black Hawk, both foaled in 1837. The latter sired Green's Bashaw in 1855. Andrew Jackson ranked and was contemporaneous with Abdallah, the latter being foaled in 1823. A little later Mambrino Chief 11 was foaled in 1844, and five years later, in 1849, Hambletonian 10 was born.

It is seen that about the middle of the past century the leading families of the Standardbred trotter had their inception, and the breed began to assume formation on this continent, for the chief families, the Canadian Pilots and others of that nationality, the Morgans, the Clays, the Mambrino Chiefs and the Hambletonians, were making it evident that there were certain blood lines more prolific than others in producing trotting speed.

Early trotting records.—The first trotting performance in America of which we have record is that of Yankee, at Harlem, New York, July 6, 1806, when a little less than a mile was trotted in 2:50. In 1859, Ethan Allen, of the Morgan line, trotted against Flora Temple, when the latter trotted a mile in 2:25. In the same year, Geo. M. Patchen beat Ethan Allen in 2:24, and in turn was beaten by Flora Temple in 2:21. Dexter, which began his racing career in 1864, defeated George Wilkes in 2:22½. According to official records, Lady Suffolk was the first to trot below 2:30, in 1845, when she won a heat in a race in 2:29½; Pelham, breeding unknown, in 1849 reduced this to 2:28; Highland Man, of Thoroughbred breeding, in 1853 reduced it to 2:27; Flora Temple reduced this several times, finally bringing it, in 1859, to 2:19¾; in 1867, Dexter reduced it to 2:17¼; and then Goldsmith Maid continued lowering it until 1874, when, going against time, she made a mile in 2:14.

The Trotting Register.—About this time the greatest interest was being taken in trotting races and trotting families, and it was further added to by the founding and compiling of the American Trotting Register by John Henry Wallace, which was begun about 1865. Wallace's Monthly and the Yearbook also gave a great impetus to the study of the pedigrees of the Standardbred horse, and out of the racing and the data collected grew the enthusiasm for better breeding.

It was not until Volume IV of the Trotting Register was published that the entries of stallions were made numerically. For that volume a standard was prepared in which performance was given precedence and pedigree a minor place. Under this standard, Volumes IV to VII, inclusive, were compiled. Various changes were made, from time to time, until we now have the following standard, as revised and adopted by the American Trotting Register Association, to take effect November 1, 1898:

"When an animal meets these requirements and is duly registered, it shall be accepted as a Standardbred trotter.

"(1) The progeny of a registered standard trotting horse and a registered standard trotting mare.

"(2) A stallion sired by a registered standard trotting horse, provided his dam and granddam were sired by registered standard trotting horses, and he himself has a trotting record of 2:30 and is the sire of three trotters with records of 2:30 from different mares.

"(3) A mare whose sire is a registered standard trotting horse and whose dam and granddam were sired by registered standard trotting horses, provided she herself has a trotting record of 2:30 or is the dam of one trotter with a record of 2:30.

"(4) A mare sired by a registered standard trotting horse, provided she is the dam of two trotters with records of 2:30.

"(5) A mare sired by a registered standard trotting horse, provided her first, second and third dams are each sired by a registered standard trotting horse."

To assist still further in the establishment of a breed, the Register Association has made known (February 5, 1908) a contemplated change in the requirements for admission to the standard, looking to the elimination of all the foregoing rules except rule number one.

Influence of the standard.

At first, the importance of the standard, both as to performance and pedigree, had an undue influence. If a horse was standard it was thought that that was all that was necessary, and if a sire succeeded in piling up a large 2:30 list that was later considered the sum total. Now breeders are also considering the fact that a performance of 2:30, with improved tracks, sulkies and appliances, does not mean much, and they are considering the amount of extreme speed as a very desirable quality, with a long line of producing lineage in the pedigree. At this point, the importance of the breeding of the dam and her value as a producer of speed entered into the operations of most breeding farms. In conjunction with this, the money-making value of colt trotters, because of the large stakes, began to receive more attention. Breeders also began to find out that a horse might be a fine "looker" and at the same time a good race horse or a getter of fine "lookers" and race horses.

Present status.—This brings us down to the present era, during which the modern breeder seeks performance, individuality and pedigree, and it is all traceable to the several stages of evolution through which the breed has gone. To guide the beginner in breeding, it may be said that nearly all the families must necessarily be embraced in up-to-date breeding operations, for the history of the breed will show that they nearly all have desirable qualities that should be apparent in the modern representation of the Standardbred horse.

Distribution.

Other governments have recognized the worth of the Standardbred trotter, for recently those of Japan and China have made large importations. Extensive sales of Standardbred trotters of high merit have been made to prominent horse-lovers and breeders in Russia, France, Austria, Italy, Germany, England, Australia and the South American countries.

Families.

The origin and importance of the heads of the several prominent trotting families has been discussed above. It remains only to call attention to the notable horses of each family.

The Hambletonian family, through the male line, includes the following sons of Hambletonian 10, with mention of some of the most noted performers:

(1) Electioneer, 160 in the list, and sire of many producing sons. Some of the holders of the fastest records representing this line of breeding, are Adbell, holding the fastest mile record, 2:23, for yearling trotting stallion; Arion, the fastest mile record, 2:10¾, for two-year-old trotting stallion; Endow, the fastest mile record, 2:14¾, for two-year-old trotting gelding; Fantasy, the fastest mile record, 2:08¾, for three-year-old trotting mare, and also the fastest mile record, 2:06, for four-year-old trotting mare. Boralma, which, with John Nolan, is joint holder of the fastest mile record, 2:08, for four-year-old trotting gelding; Major Delmar, the fastest mile record, 2:05½, for five-year-old trotting gelding; Bingen, the fastest mile record, 2:06¾, for five-year-old trotting stallion, held jointly with Ralph Wilkes. In addition, Sunol, 2:08¼, held the champion trotting record in 1891; The Abbot, 2:03¼, held the champion trotting record in 1900, and Palo Alto, 2:08¾, was champion trotting stallion in 1891. In summing up the standing of the families in regard to the production of colt trotters, Volunteer, in a very able tabulation,[1] gives Electioneer second place to George Wilkes, with thirty-three sires and seventy-one performers.

(2) George Wilkes, 83 in the list, and sire of many notable producing sons. Some of the holders of the fastest records representing this line of breeding are Belle Acton, holding the fastest mile record, 2:20¾, for yearling pacing mare; Extasy, the fastest mile record, 2:10¾, for two-year-old pacing mare; Peter Sterling, the fastest mile record, 2:11½, for three-year-old trotting gelding; Hymettus, the fastest mile record, 2:08½, for three-year-old pacing gelding; Palmyra Boy, the fastest mile record, 2:07¼, for four-year-old pacing gelding, held jointly with King of Diamonds; Brenda Yorke, the fastest mile record, 2:08¾, for three-year-old pacing mare; Online, the fastest mile record, 2:04, for four-year-old pacing stallion; Coney, the fastest mile record, 2:02¾, for five-year-old pacing gelding; Searchlight, 2:03¼, joint holder with Audubon Boy of the fastest mile record for five-year-old pacing stallion; and Ralph Wilkes, the fastest mile record, 2:06¼, for five-year-old stallion, held jointly with Bingen. In addition, George Wilkes, 2:22, held the champion stallion trotting record, in 1868–71; Axtell, 2:12, held the champion stallion trotting record in 1889; Allerton, 2:09¼, held the champion stallion trotting record in 1891; Dariel, 2:00¼, is the fastest pacing mare, and Dan Patch, 1:55¼ (Fig. 476), is the champion pacing stallion. In the production of colt trotters, Volunteer gives this line first place, with forty-seven sires and ninety-eight performers.

(3) Abdallah 15, 5 in the list, and sire of many notable producing sons. Some of the holders of the fastest record of this line are Pansy McGregor, the fastest mile record, 2:23¾, for yearling trotting filly, and Paul D. Kelly, the fastest mile record, 2:20¾, for yearling pacing colt. In addition, Cresceus (Fig. 495), 2:02¼, is the champion trotting stallion, as well as holder of a great many world records for different distances and

[1] Horse Review, January 28, 1908.

heats. Nutwood leads all other sires as sire of producing brood mares. This line has been notable for the production of campaigners and race horses rather than for colt trotters, although Volunteer ranks it among Hambletonian 10's sons, with ten sires and sixteen performers. Such race horses as Robert McGregor, 2:17½, Cresceus, 2:02¼, Nutbearer, 2:09¾, winner of the fastest eight-heat race on record, and Highball, 2:06½, the fastest green gelding of 1907, and Nutboy, 2:07¼, Turley, 2:07¾, Robert Mac, 2:08¼, were of this line. Goldsmith Maid, 2:16¾, of this strain, the champion trotter in 1871–72, and again in 1874, when she reduced her record to 2:14, has been conceded to be the greatest campaigner of any time.

(4) Happy Medium, 94 in the list, and sire of many notable producing sons. Nancy Hanks, 2:04, was the champion trotter in 1892, and Maxie Cobb, 2:13¼, was champion trotting stallion in 1884–89. In his table of sires of colt trotters, Volunteer ranks Happy Medium seventh among Hambletonian 10's sons, with two sires and six performers.

(5) Dictator, 52 in the list, and sire of many notable producing sons. Some of the holders of the fastest records in this line, are Directly, holding the fastest mile record, 2:07½, for two-year-old pacing stallion, and Directum (Fig. 44), holding the fastest mile record, 2:05¼, for four-year-old trotting stallion. In addition, Jay Eye See, 2:10, was champion trotter in 1884; Phallas, 2:13¾, was champion trotting stallion in 1884, and Directum, 2:05¼, was champion trotting stallion in 1893. This line is also noted for its number of race horses, trotting and pacing, for it includes Director, 2:17, Directum, 2:05¼, Direct Hal, p., 2:04½, Direct, p., 2:05½, and Norman B, 2:05¼, winner of fastest four-heat race in 1907. In the production of colt trotters, the writer, Volunteer, in reference already given, places Dictator fourth as his rank among the sons of Hambletonian 10, with six sires and sixteen performers.

(6) Strathmore, 62 in the list, and sire of several notable sons. Klatawah, 2:05½, is the holder of the fastest mile record for three-year-old pacing stallion. Lou Dillon, 1:58½, of this line is the champion trotter of the present time. This line ranks very high in producing brood mares.

Among other noted sons of Hambletonian 10 are Egbert, 85 in the list; Aberdeen, 52 in the list; Harold, 45 in list (sire of Maud S, 2:08¾, champion trotter 1883–5, and sire of Lord Russell, sire of Kremlin, 2:08¼, champion stallion in 1892); Volunteer, 34 in list (sire of St. Julien, 2:11¼, champion trotter in 1880); Jay Gould, 29 in list and champion stallion in 1871–2. The Hambletonian family as a whole is given first place by Volunteer for siring colt trotters, with 106 sires of 223 performers to its credit.

The Mambrino Chief family, through the male line, includes the following sons of Mambrino Chief 11, with mention of some of the most noted performers:

(1) Woodford Mambrino, 13 in the list, and sire of several notable producing sons. Helen Hale is holder of the fastest mile record, 2:13½ for two-year-old trotting filly, and John Nolan is holder of the fastest mile record, 2:08, for four-year-old trotting gelding. Alix, 2:03¾, was champion trotter in 1894. In the table that Volunteer has prepared, Prodigal is credited with eleven colt trotters, which places him in the lead of all sires of colt trotters. A striking feature of this line is the purity of the trotting gait, for there are but few pacers among them.

(2) Mambrino Patchen, 25 in the list, sire of several notable producing sons. This line has a reputation, to which it is entitled, for having in its ranks a large number of producing brood mares. Many noted stallions, sons of George Wilkes, have Mambrino Patchen dams, a blend that has been prolific in speed.

(3) Clark Chief, 6 in the list, sire of Kentucky Prince, 41 in the list, which in turn is sire of Dexter Prince, 62 in the list. Dexter Prince sired Eleata, 2:08½, Lisonjero, 2:08¼, and James L., 2:09½.

(4) Mambrino Pilot, 9 in the list, sire of Mambrino Gift, Caliban, Hannis, and others. Mambrino Gift, 2:20, was champion trotting stallion in 1874.

The Clay family is generally considered to start with Henry Clay, but it really traces back through the male line to Grand Bashaw, imported in 1820 from Tripoli. The latter was fourteen and one-fourth hands high, but was reputed to be a horse of beauty and some speed for those early days. Grand Bashaw was bred to Pearl by First Consul out of Fancy by Messenger, and from this union resulted Young Bashaw, the sire of Andrew Jackson. Andrew Jackson was a trotter of note in his day, especially as a two-miler. The Long Island Black Hawk line has given us Bashaw 50, 17 in the list and Wapsie, with 11 in the list. Bashaw 50 is the sire of the dam of Joe Young, 2:18. Henry Clay sired Cassius M. Clay 18, which sired Geo. M. Patchen, 2:23½, champion trotting stallion in 1859–60, and sire of four trotters. Perhaps the most prolific speed line comes through Cassius M. Clay 20, a son of Cassius M. Clay 18, for Harry Clay, 2:29, with four trotters in the list and sire of the dam of Electioneer, is by C. M. Clay 20, and Clay Pilot is also by the latter. Clay Pilot sired The Moor, 6 in the list, sire of Sultan, 2:24, 52 in the list, sire of Stamboul, 2:07½, sire of forty-eight trotters in the list. Stamboul, 2:07½, is generally conceded to have held the stallion record, but it was disqualified because of a small technicality which many did not accept. This family attains its notoriety most largely through the remarkable great brood mares that are of this descent, among which may be mentioned Green Mountain Maid (by Harry Clay), dam of nine trotters, including Electioneer and Beautiful Bells, dam of eleven trotters and eight producing sires.

The Morgan family takes its name from Justin Morgan by True Briton by Imported Traveller by Morton's Traveller, which traces in near and direct lines to the Byerly Turk, Curwen's Bay Barb, the Lowther Barb, Bloody Buttocks and the Godolphin Arabian. In his book, published in 1857, D. C. Lindsley describes Justin Morgan as about fourteen hands high and weighing 950 pounds. His color

was dark bay, with black points. He was a very stylish horse, of indomitable, though easily controllable spirit. The three sons of Justin Morgan that were most prolific as sources of trotters were Sherman, Woodbury and Bulrush. Sherman sired Black Hawk 5, sire of 3 in the list, and also sire of Ethan Allen, 2:28, champion trotting stallion in 1858. Ethan Allen sired Daniel Lambert, the sire of 38 trotters in the list, including Ben Franklin, sire of 33 trotters in the list, and Aristos, sire of 30 in the list. Black Hawk 5 also sired King Herod, sire of Herod, 2:24½. Vermont Hero was also a son of Black Hawk 5, and he sired General Knox, sire of 15 trotters, including Charles Caffrey, sire of 19 trotters in the list. General Knox sired General Washington, sire of 15 in the list, including Poem, 2:11½, with 24 in the list. Flying Cloud 134 is another son of Black Hawk 5, that sired Trojan, the sire of Ben Lomond, a producing sire.

From the Bulrush line comes Old Morrill, sire of Young Morrill, sire of Winthrop Morrill, sire of 9 in the list, including Draco, the sire of Draco Prince. Winthrop Morrill also sired Fearnaught, 2:23½, sire of 5 trotters in the list, in turn the sire of Royal Fearnaught, with 25 in the list. The other son of Justin Morgan, namely, Woodbury, sired Morgan Eagle, whose son of the same name got Magna Charta, sire of 5 in the list. Woodbury also sired Barnard Morgan, which in turn sired Vermont Morgan, sire of Golddust, the founder of that strain. The fastest trotters of the Morgan line include Lord Clinton, 2:08¾, Lamp Girl and Ethel Downs.

While the Morgan family has produced considerable speed, yet its popularity is based chiefly on the endurance, beauty and style of its members. Pacers are exceptionally rare among them, and the purity of their action being bold, free and tireless, is perhaps the most valuable attribute of the family. In this connection, it may be stated that the government, having recognized the tractable and energetic disposition of the Morgans, as well as their well-established reputation for endurance, has established a breeding station in Vermont in coöperation with the Vermont Agricultural Experiment Station, with the object of "saving the Morgan." There are twenty-three horses in all in this stud, headed by the stallion General Gates by Denning Allen (the sire of Lord Clinton 2:08¾) and out of a Thoroughbred mare. Carmon, the stallion at the head of the stud at Fort Collins, Colo., in the efforts to establish a breed of American carriage horses, carries some Morgan blood.

The blood of the Morgan horse has become rather widely scattered over America, although there are comparatively few Morgans available. Most of these are found in New England and other eastern states, although there are pure-blooded Morgans in parts of Iowa, Indiana, Illinois, Kentucky and Missouri. The American Morgan Horse Register is published at Middlebury, Vermont.

The Pilot family takes its name from old Pilot, a Canadian pacer from near Montreal, afterwards trained at both gaits. After passing through many hands and sojourning in Connecticut, New York, and Louisiana, he reached Kentucky in 1832. There he sired Pilot Jr., out of a mare of Thoroughbred breeding. He sired eight trotters in the list, but his blood was chiefly valuable through the female line because of the number of great brood mares he sired. Pilot Jr. sired Tattler, sire of 5 in the list, including Indianapolis, sire of 10, and Rumor, sire of 24 in the list. Another son of Pilot Jr. was Woodburn Pilot, sire of Argonaut, with 5 in the list. Among the brood mares sired by Pilot Jr., Miss Russell is most noted.

Other families.—In addition to the foregoing recognized families, there are a number of others that have been very aptly termed the submerged families. Many of these are of Thoroughbred origin, but they are mostly of Canadian pacing origin. Among those of Thoroughbred breeding are American Star 14, sire of the dams of Guy, 2:09¼, Dexter, 2:17¼, Robert McGregor, 2:17½, Aberdeen and other noted sires. Blackbird 401 is another Thoroughbred that enters into many trotting pedigrees. His son, Blackbird 402, sired 3 in the list, and another son, A. W. Richmond, sired Columbine. The Canadian pacing families are discussed in more detail in the history of the Standardbred pacing horse.

Uses.

For racing.—The Standardbred trotter occupies a position about equally divided between pleasure and utility. The degree to which the trotter embraces the former field depends on the popularity of racing, both in the circuits and for matinee purposes. Trotting races are an adjunct of nearly every county fair, and occupy a prominent position at all state fairs. However much the attendant gambling may be deplored, the fact remains that trotting and pacing races are popular, and they also assist in developing a speedier and more durable breed of horses. The racing is under the jurisdiction of the National Trotting Association and the American Trotting Register Association, the rules governing the races, under the auspices of either, being almost identical; and they prevail at all race meetings and on all tracks over which officially accepted records are made.

For matinee racing.—After having finished their racing career and having reduced their records so that their money-winning capacity is reduced, many trotters are purchased for matinee racing in our larger cities. This sport has grown in popularity to such an extent that a national League of Amateur Driving Clubs has been formed.

As a roadster.—It is as a roadster that the trotting-bred horse is most useful. This demands a horse of medium height, 15.2 to 16 hands, of graceful lines, without the least tendency to coarseness in any part. Quality of bone, cleanness of limbs, defined tendons and all other characteristics that forecast durability, should be very much in evidence. With it all there is a refinement of form that differentiates this type from the coach or heavy-harness class. Easy, elastic action and an ever-present willingness to cover the ground in jaunty style are desirable characteristics. At an early day, the Thoroughbred was recommended

strongly for crossing on common light mares, and such breeding resulted, in many instances, in roadsters noted for their ability to cover long distances at the trot, and to continue it day after day. The Morgan horse, however, was soon recognized as the strain possessing the highest type of roadster characteristics, chiefly because of its indomitable perseverance and endurance, its willingness, and the style and buoyance with which it stood the strain of continuous road riding. The roadster, in addition to having style, action and durable individuality, must be in type in harmony with the light harness and light, easy-running road rigs now popular. A heavy, slow, but maybe stylish-moving horse is as much out of place before a road rig as a slim racer-like horse would be in heavy harness. While there are many speedy trotters that are far from pleasurable road horses, because the ability to go fast for a short distance is not the chief requirement of a road horse, yet the result of the continuous racing which the trotter has undergone, undoubtedly has given it the durability and the "do or die" spirit that is a valuable attribute of the roadster. At this day some speed is required of the roadster.

As heavy harness horse.—Of recent years, attention has been drawn to the fact that some families of the American Standardbred horse have shown marked excellence for heavy harness use. During the time when the horse-shows were perhaps most popular, about 1890, the breeding of the trotting horse was under a depression. For that reason, many stallions, well bred in trotting lines but of heavy harness conformation and action, were purchased at gelding prices and shown in heavy harness classes at the leading horse-shows. Undoubtedly they may properly be called freaks, for they were not bred for this purpose, but that does not dispose of the worth of the acquisition. The trotting-bred heavy harness horse and high stepper became a strong competitor of the Hackney, and in some instances defeated the latter in these classes. The result has been that the government has realized the possibility of establishing a family or, in time, a breed of heavy harness horses as an offshoot of the Standardbred trotter. The Colorado Experiment Station is conducting the work under the auspices of the Department of Agriculture at Washington. Carmon 32917, a grandson of Robt. McGregor, 2:17½, is at the head of the stud. Previous to purchase by the government, he had been a prominent winner at leading horse-shows in the harness classes under the name of Glorious Thunder Cloud.

For breeding "cow ponies."—At this point, to indicate further the versatility of the Standardbred trotter, it will not be out of place to mention the fact that on many of the large cattle ranches, where "cow ponies," as they are called, are in heavy demand, the Standardbred trotter is being used as a sire in preference to the Thoroughbred. The reason for this preference was given the writer to be the better disposition of the Standardbred as compared with the Thoroughbred, said to be a result of the restraint under which the trotting horse has been held, and the necessity of a trotter having a controllable disposition.

Organizations and records.

The National Trotting Association was organized in 1870. The office of the present secretary is at Hartford Conn. The American Trotting Association was organized in 1887, and has headquarters in Chicago. The American Trotting Register appeared in 1868, with J. H. Wallace as publisher. The first volume contained some 3,000 entries. Wallace also established the Yearbook, now in its twenty-third volume. The Register, the Yearbook, and Wallace's Monthly were disposed of by Mr. Wallace to the American Trotting Register Association, in 1891, and the latter now publishes the Register and the Yearbook. As has been said, a League of Amateur Driving Clubs has been formed, with headquarters in Boston. This league publishes a yearbook, giving a summary of matinee races and the time made. The first volume includes the races of 1901–2.

Literature.

Busby, The Trotting and Pacing Horse in America, New York (1904); Helm, American Roadsters and Trotting Horses, Chicago (1878); Linsley, Morgan Horses, New York (1857); Lowe, Breeding Race Horses by the Figure System, New York (1898); Marvin, Training the Trotting Horse, New York (1892); Merwin, Road, Track and Stable, Boston (1893); Splan, Life with the Trotters, Chicago (1889); Woodruff, The Trotting Horse of America, Philadelphia (1868). [For further references, see page 416.]

MULE. Figs. 496, 497.

By *Charles Wm. Burkett.*

The mule is a draft animal. It is not a true breed, but is a hybrid, a cross between the horse and the ass. An offspring of the male ass or jack and the mare is known as a *mule*, while the progeny of a stallion and a female ass is designated as a *hinny*.

Description.

Of these two classes, the mule is the more valuable, since there is greater size, to which are added style, finish, strong bone, and other requisites that go to make the animal so valuable for draft purposes. From this description it follows that the hinny is smaller in size, somewhat unsightly in form, lacking in finish, and adapted to environments that call for lighter work and effort. Still, the hinny is able to endure drudgery and hardship equal to and often greater than the mule.

Like all other animals, the mule and the hinny naturally inherit qualities from both parents. With the former, the body follows the maternal type, but closely adheres to the paternal side in the head, foot, ear and bone. The voice of the mule is not like that of the jack, as popularly supposed, but slightly resembles it. From the paternal side come also patience, endurance, faithfulness and

ability to do hard work and much of it; and from the mother come those qualities that have made the horse so prominent and so famous, namely, courage, hardiness and strength.

Points of the ideal type.—The mule that most nearly approaches the ideal type follows the horse closely in all points of symmetry of form. The body, however, is commonly more cylindrical and somewhat smaller than the body of the horse, a factor not altogether in favor of the mule. A large body, therefore, is more desirable than a small body; but largeness of body must not be confused with paunchiness, for this is always objectionable. The type in which the body conforms as nearly as possible to that of the ideal draft horse should be selected. Producers of mules are realizing that a critical trade is demanding mules of a superior conformation in the region of the body, much more so than this same trade demanded a few years ago.

Fig. 496. A good representative of the large heavy mule.

Mules that most nearly meet the ideal type possess fine, hard legs, showing superiority with every movement. The bones should be smooth and dense; the tendons should show considerable prominence; and the muscles must be well developed. While the feet of the mule are narrower and longer than those of the horse, a large foot is always to be desired.

History.

The mule has been known from the earliest times, some of the old Roman writers having discussed the mule in their descriptions of Roman agriculture.

In America.—In America, the mule has been in use from colonial days. As early as 1591, jacks were brought to this country by the Spaniards. The first of the kind, no doubt, went to Mexico. With a more settled condition in our country, and a demand for better work animals, the mule came. One of the first men to engage in the production of mules was General Washington (see page 276). The superior qualities of the mule were early recognized by southern planters. During the first half of the nineteenth century mule-breeding extended over much of the country.

Distribution.

The mule is distributed throughout the world. An English writer describes the geographical distribution as follows: "The mule line extends north from the equator, including Africa and Europe, up to 45° of latitude, and in Asia and North America as far as 35°. On the south side of the equator we can include most of Africa, the northern part of Australia and South America, as far south as 35°. Within this vast radius hundreds of thousands of mules are bred each year. Many of the mules are big, heavy animals, with great power and bone, and stand sixteen to seventeen hands high."

In America.—Mules are now found in use in every state in the Union, but more largely in the southern states. The table below shows the ten states having the largest numbers of mules, according to the census of 1900:

Missouri	242,095
Tennessee	238,976
Mississippi	206,678
Georgia	205,832
Alabama	187,375
Kentucky	169,955
Arkansas	166,267
Louisiana	141,645
North Carolina	132,534
South Carolina	116,849

Kentucky and Tennessee have been noted from early days as mule-breeding centers. To these states, many noted jacks have gone, not native only, but those representing the best of the Andalusian, Catalonian, Majorcan and the Maltese types. During recent years, it has been learned that while soil and climate may influence quality in the individual, care in the selection of feeds and in the breeding types are also fundamental among the requisites of successful mule production; and hence, where these latter are heeded, mules may be produced. Consequently, Texas, Georgia, Missouri, Kansas, and Oklahoma, as well as many other states, are vying with Kentucky and Tennessee in producing mules of high quality that find favor in all parts of the world.

In 1906, the estimated number of mules in the United States was 3,404,361, valued at $334,660,000, an average valuation of nearly one hundred dollars per animal.

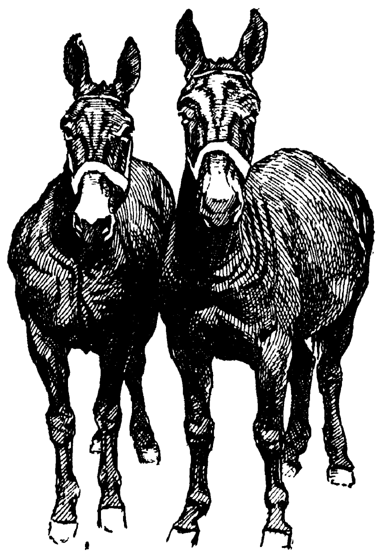


Fig. 497. A matched mule team.

The breeds of jacks.

Up to the time of the Civil war, but two breeds of jacks were used, the Maltese and the Spanish. The Andalusian and Catalonian from the mainland, and the Majorcan, from the island of Majorca, were formerly known as Spanish. So great has been the demand for jacks of Malta that practically all have been exported, and now but few are left on the island.

The jacks of Italy have not been successful as

mule-producers in this country, and consequently have entered but slightly into the mule stock here. At the present time, there are three noted breeds of jacks: the native, the Poitou, and the Catalonian. In regard to favor and importance, perhaps, these breeds should be ranked as mentioned here. Many of our noted mule-breeders prefer native jacks to those of foreign breeds. The native jack produces a good finish, a good form, strong legs, broad hocks, and is already peculiarly adapted to our environments. Besides these qualities, he extends to his progeny immunity from diseases to an unusual degree, and an exceptionally long life.

The Poitou jack is a French breed of Spanish origin, and is ranked by some breeders as first among jack breeds. He is liked especially for agricultural use, because of the size of his limbs and feet. The legs are short and straight with plenty of bone, while the pasterns are short, as required of a draft animal. The legs are flat and hard, whilst the feet are large and more expanded than those of any other breed of jacks. In this respect, the Catalonian jack is not equal to the French breed, although the Catalonian is finer in limbs than the Poitou.

With the Poitou jack, both the head and ears are enormous; in fact, French breeders are inclined to regard these as of very great importance,—more valuable than the smaller kind. The neck is strong, thin and broad. There is a want of withers, but this is true of all jack races. The broad chest and enormous legs of the Poitou jack promise much in mule-breeding.

The Poitou jack varies from thirteen and one-half to fifteen hands, which is about the height of native, Catalonian, and other Spanish breeds. The height of a jack is not nearly so important as the character of the head, ears, legs, feet and barrel. If height can be secured from the dam, it is better to sacrifice height in the jack, in order to get other and more desirable qualities. The breed is of less importance than individual qualities.

Prices for individuals of the Poitou breed are a little higher, perhaps, than for either the Catalonian or native, but it is possible to get a good Poitou jack for $1,000 to $1,500, although some have sold at $2,500 to $3,500 each.

Raising.

The raising of mules is demanding more attention from year to year. Some of the reasons for their increasing popularity may be briefly summarized as follows: (1) It costs less to breed and raise a mule to a suitable size than a horse. (2) Less time is required to prepare a lot of mules than a lot of colts for the market. (3) Young mules may be sold readily at any period, and in any amount. (4) Mule colts uniformly command a higher price than horse colts of similar relative quality and value. (5) Mules are subject to fewer diseases and less liable to serious accidents.

The type of jack to use.—The jack for mule production should be at least fifteen hands high and should carry a maximum weight. By this is not meant that the jack must be fat; rather, large size, that with it may go heavy bone, a broad chest, and great strength in the region of the hips. Connected with size will usually be found a rather large head, somewhat heavy and coarse, and not of the best quality; but it is better to sacrifice quality here so as to secure weight and substance, requisites of the first importance with the mule. A large heavy foot is desirable also, and to these qualities should be added all the style that is attainable.

The kind of mare to breed from.—A common error is to suppose that as soon as a mare becomes diseased and unfit for horse-breeding she may be used for the production of mules. Perhaps this accounts for so many inferior mule colts. It matters not how superior the jack may be, unless the dam is equally sound, and of equally good conformation, one will seldom succeed, if ever, in producing colts of high quality and of great usefulness. A mare that is sound and free from blemishes is to be chosen. She must possess good length, with a large well-rounded barrel; her head must be fine and clean, and attached to a neck of desirable proportions; her chest should be broad, her hips wide; and, finally, her style, bearing, and breeding should be of high order.

For the production of large mules, large draft mares only will serve. One may take good grade mares of the Percheron, Clydesdale, or Belgian breeds; either is good and all are satisfactory. These are the breeds most commonly used, but grades of any of the draft breeds will do.

Color.—Perhaps color is but a play of the fancy. Still, in the case of the jack it suggests lineage and purity of breeding. Generally speaking, a dark color is preferable, if not altogether demanded of the jack. Black, with white points, is the best fashion. With mares, let the color be dark also: bay, black, brown or chestnut. Good color in the dam will help with good color in the colt, a matter of no small importance if a discriminating public is to be catered to. Otherwise, one need not bother. There is no special merit in the color, and the breeder must be careful not to sacrifice quality and size and substance for color.

Feeding.

There is a prevailing opinion that mules may be fed on less food than horses of the same size and weight; but this is an error. While it may be true that the mule will utilize inferior feeding-stuffs to a better advantage than his more aristocratic associates, still, to do the work that he is called on to do, demands for the mule a quantity of food equally as great as that of his horse relatives. The mule has marked preference for certain foods, or a marked dislike for other foods, a discrimination even more sensitive than that of the horse.

Market classes of mules.

Mules are generally grouped into four general classes on the larger mule markets.

(1) *Sugar and cotton mules.*—The first class that may be mentioned is the cotton and sugar mules. While these are raised in the West, a great majority of them find their way into the southern

states, where they are used on cotton-farms or sugar-farms. It is a good class of mules that goes into this section. They are large, heavy, and of splendid type. On the Kansas City market the cotton and sugar mules stand fifteen to sixteen hands, while the Chicago market calls for a somewhat higher animal. The cotton or sugar mule that stands sixteen hands should weigh 1,050 to 1,350 pounds.

The class of mules that is used on the sugar plantations is of the best quality, owing to the fact that the sugar plantations are worked by wealthy syndicates that could not afford to use poor mules. It shows a very smooth finish, a marked refinement about the head and neck, and a fine quality of bone. In fact, no class is superior to the sugar mule in smoothness and finish and polish. The sugar class of mules shows also greater uniformity in quality, height and weight than do those used for any other purpose. Cotton mules, as a rule, are poorly graded, and lack the uniformity observed in the sugar class. Both cotton and sugar mules begin service, usually, at three or four years of age, although some at five years; but they are at their best age when six to nine or ten years of age.

(2) *Lumber mules.*—For the necessities of the woods, where mules are used in great numbers for purposes of lumbering, a very heavy, strong and rugged animal is needed; hence, we find the lumber mules extremely tall and large, usually fifteen to seventeen or more hands in height. Quality is not of so much importance as the ability to do hard and rough work, and a lot of it; therefore, weight is especially essential when heavy logs are to be moved. There is great variation in this class of mules, everything being sacrificed excepting capacity to do hard work, ruggedness to endure hardships and fatigue, and size and height to supply power.

(3) *The general-purpose mule.*—The general-purpose mule is more or less familiar to the reader. This animal is seen wherever railroad construction is in progress; he is often observed on the farm; he is found on the roads wherever heavy hauling is being done, in the cities, in towns, along rivers. One of the requirements of this class is that it be rugged, strong, and capable of doing hard work. It is this class that competes with the ordinary draft horse, and compared with the average draft horse it is superior for many kinds of work. In height this class ranges from fifteen to sixteen and one-half hands. The weight varies from 1,000 to 1,400 pounds. The Chicago market grades the general-purpose mule a little heavier and a little higher than either the Kansas City, the St. Louis, or the St. Paul markets.

(4) *The mine mule.*—Mine mules are generally classed as either pitters or surface mules. They grade into the smallest of these four groups, standing ten and one-half to fifteen hands high, are chunky and hardy, and possess a heavier bone in proportion to size than those of the other classes. The white mule is never used in the mines, for the reason that it tends to frighten other animals; hence, dark bay or black are the only colors desired for this purpose. Those mules selected for the pits are of heavy bone and of good weight, capable of long, steady pulls with rather heavy loads. The surface class, while heavy, are somewhat taller than those in the pit, and may be lighter in bone.

Use.

The mule is a draft animal, found wherever drudgery is performed and strenuous effort demanded. If the earth on which the feet must go is broken, marshy and wet, there you will find the mule in use; if climates are hot and sultry and harmful to health; if paths are precipitous and dangerous, requiring surefootedness and steadiness; if bold courage and large demands are made, it is the mule that is drafted into service, because it is well known that he will be found equal to meet the occasion. He is found in the cotton-fields of the Black-belt, in the sugar-fields of the South, on the stiff prairie lands of the West, on the difficult mountain trails. The mule has been born and bred to this environment. In it he serves better than any other beast of burden, for he asks less and does more; because he enjoys immunity from disease in a large measure; because his span of life is many years; and because his demands on his master are few, simple and reasonable.

The mule has also a place as a saddle and a carriage animal, notably in parts of the South and the central West.

Disease immunity.

The mule shows considerable disease immunity, which gives him a marked advantage over the horse. While it is not true that he is exempt from disorders or complaints, as has been said at times, it is to be said to his credit that he is not so liable to disease or disorders as the horse, and even when affected with certain ailments he is likely to be less disabled than the latter.

Organizations and records.

It has been within the last fifteen or twenty years only that a national society in America has undertaken to advance the interest in jacks, jennets, and in mule-breeding. An American association, called the "American Breeders' Association of Jacks and Jennets," has published to date six stud-books. The first one appeared in 1891. The number of jacks and jennets registered to date is about 1,700. The office of the secretary is at Columbia, Tennessee.

Literature.

Harvey Riley, The Mule; Tegetmeier and Sutherland, Horses, Asses, Zebras, Mules and Mule Breeding; Burkett, Our Domestic Animals; Plumb, Types and Breeds of Farm-Animals; Feeding Horses and Mules, Bulletin No. 72, Florida Agricultural Experiment Station; Feeding Farm Horses and Mules, Bulletin No. 189, North Carolina Agricultural Experiment Station. [For further information, consult the references cited on page 416.]

OSTRICH. *Struthio*, spp. *Struthionidæ.* Figs. 498–500.

By *Watson Pickrell.*

The ostrich is the large African running-bird. It has been successfully domesticated in America and elsewhere for its feathers. Most of the ostriches in America are from South Africa, and are of the species *Struthio australis*. There are a few from North Africa of the species *S. Camelus*.

Description.

The ostrich is very much the largest of any existing bird. A full-grown fat ostrich will weigh 375 to 450 pounds, and will stand eight feet high, but can easily reach to a height of ten or eleven feet. "There are no true down feathers but the contour-feathers are soft and lax, with free barbs and no aftershaft, and are distributed uniformly over the skin. On the body the plumage is black or blackish, with the quill plumes of the wings and tail white. The head and neck are nearly and the legs quite naked." Wings and tail are not prominent, and the former are not used for flying but are of much assistance in running. The plumes are very pretty. The neck is long, upright and curved, and the head small. The speed of the bird is great.

History.

About the middle of the nineteenth century, the inhabitants of the South African colonies saw the ostriches fast disappearing. They enacted laws restricting their slaughter, and later passed laws prohibiting their slaughter altogether. For ages there have been ostriches kept in captivity in menageries and zoölogical gardens. About 1865, persons in South Africa began to domesticate them for feathers. Before they were domesticated, nearly all the ostrich feathers of commerce were taken from dead birds.

In America. - The first ostriches imported for farming in America were introduced by Doctor Sketchley in 1882. He left South Africa with two hundred, and landed in California with twenty-two. In 1884, fifty-five ostriches were imported, and in 1886, forty-four more, all from Africa to California. In 1901, there were twelve ostriches imported from Nubia; six went to California and six to Arizona. All of the ostriches in America came from these importations.

Ostrich-farming in America is really only in its infancy. It has been only twenty-six years since the first ostrich-farm was started. The early attempts met with varying degrees of success. The pioneer breeders in this county had to get most of their knowledge from their own experience. In fact, more than half the ostriches now in the United States are the progeny of a single pair owned in Arizona in 1891. Great progress has been made in the last five years, and there are now 2,500 ostriches on farms in the United States.

Distribution and adaptation.

Ostriches thrive best in a warm, dry climate, but can be grown in any of the southern states and territories in this country. In a moist climate they should have protection from cold and rain. Of the ostriches in America, over two-thirds are in Arizona, and the remainder in California, Florida and Arkansas. Salt River valley, Arizona, is thought to be the best place in the United States for ostrich-farming. They are also found in Egypt, North and South Africa, and Australia.

Raising.

The description of methods which follows is based almost entirely on the experience and observation of the writer, and applies especially to ostrich-farming as practiced in Arizona.

Fig. 498. Four-year-old male ostrich.

Ostriches come to maturity when about four years of age. The female matures six months to a year before the male, but she will seldom lay a fertile egg until she is three and a half years old. The nest is a round hole in the ground which the male scoops out with his feet. At first, the female may not take to the nest, but may lay her eggs on the ground, whereupon the male will roll them into the nest. Generally, after the male has put three or four eggs into the nest, the female will lay there. In about thirty days she will lay twelve to sixteen eggs, and will be ready to begin incubation.

Incubation under domestication is effected in two ways: (1) By natural and (2) by artificial means. Some growers prefer the first method, others the second. Either has been found to yield satisfactory results with fertile eggs. About forty-two days of very careful attention are required for good results.

(1) *In natural incubation*, the male takes a prominent part, covering the eggs fifteen or sixteen hours out of the twenty-four. He will usually go on the nest about five o'clock in the evening and remain there till eight or eight-thirty the next morning, the female taking her turn during the day. It is thought that the color of the sexes has had something to do with developing these instincts. The male, being black, is not so easily seen at night, and the female, being drab or nearly the color of sand, can not be seen so readily in daylight. The male usually begins sitting three or four days before the hen stops laying. If the weather is cold during the laying period, the male may often be found covering the eggs at intervals during the night to prevent their becoming chilled. The birds are also very watchful during the warmest season to prevent the eggs from becoming overheated by the sun. Often, in the heat of the

OSTRICH

day, one or the other of the old birds may be found sitting on its ankle joints with both wings extended to shade the eggs from the sun. The careful ostrich-farmer should make this work unnecessary by providing artificial shade during the hot season. The birds sit very much closer to the nest during the first half of the incubation period, the internal heat of the eggs making this less neces-

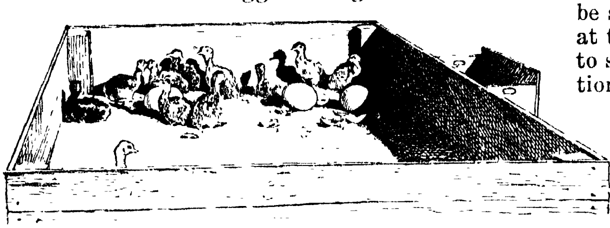


Fig. 499. Ostrich chicks just from the shell.

sary during the last half. As is usually the case with all eggs in a dry climate, the shell of the ostrich egg becomes dry and hard, and very difficult for the chick to break. When the time arrives for the liberation of the young, they will be heard to chirp and to move in the shell. The parent bird seems to understand the situation, and will often crack the shell with its breast-bone, sometimes taking the young bird by the head and drawing it out of the shell. Sometimes three or four days elapse between the hatching of the first and the last eggs in the nest. During this time one or the other parent bird takes care of the chicks, while the other is attentive to the nest. Owing to liability of injury to the young birds by reason of anxiety of the parent birds, it is a good practice after the first eggs have hatched to remove the remaining eggs to an incubator.

(2) *Artificial incubation* can be performed successfully with any good, well-regulated machine that will hatch eggs of common fowls, provided, of course, it is constructed on a large enough scale to accommodate ostrich eggs, which are five inches in diameter and seven inches long. It has been found best to use an incubator that will hold only thirty to thirty-five eggs, as, in case of a blunder or an accident to the incubator, the loss will be comparatively small. The incubator should be heated two or three days before the eggs are put in, to see that everything is in proper working order. The incubation should be started at a temperature of 101° Fahr. In three weeks this temperature will be slightly increased by the heat generated in the eggs themselves. Every egg should be turned at least once or twice a day. To be on the safe side it is well to adopt the rule of turning the eggs three times daily.

The regulation of the temperature is not the only thing to be considered in hatching eggs in an incubator. The question of moisture presents a serious problem. Inside the shell of the egg are two fibrous coats, one of which adheres closely to the shell and the other incloses the contents, they being separated at one end of the egg by a small air space. This air space should be closely watched by the attendant, as its size indicates the moisture condition of the egg. If this space becomes abnormally large, small pans of water should be placed in the incubator; if it becomes too small, the moisture should be reduced. An intelligent and watchful attendant will experience no difficulty in this matter. Moisture pans are seldom required before the fourth week.

In a warm climate, the incubator house should be so constructed as to be as cool as possible, and, at the same time, free from drafts and not subject to sudden changes. During the period of incubation the attendant should observe the growth of the embryo at least once every two days. This he can do by shading the egg with the open hand and holding it to a lighted candle. Careful observation will enable him to detect and remove the infertile eggs by the end of the second week; but whenever there is room for doubt, the egg should be allowed to remain longer, perhaps to the end of the third week, when the internal heat of the eggs will be sufficient to indicate, unmistakably, the live eggs. Near the end of the sixth week the eggs should be watched more closely. By placing an egg to the ear one can hear the unhatched chick scratch the inside of the shell and chirp; also, the air space will be observed to become filled up. It is then time to crack the shell and thus aid the chick in liberating itself.

It is not well suddenly to transfer a newly hatched chick from the incubator temperature of 101° to that of the open air. A well-ventilated brooder kept at 90° Fahr., is the proper place for the first twenty-four hours, after which the temperature may be brought gradually to that of the outside air. The chicks should never be allowed to become damp or cold, and they should not be fed for the first three or four days, but they may be allowed to pick up sand or gravel. Dry feed is preferable for the first week. Cracked wheat and moistened bran are excellent, but the chicks should never be given feed that has begun to sour. The inclosure should always be kept clean. At the end of the first week, green alfalfa cut very fine may be fed, but not too freely at first. It should not be allowed to become dry. Fresh feed should be the ostrich-farmer's watchword at all times.

Young ostriches, like young chickens, should be housed and protected from cool drafts until they are two or three months old, the length of time depending somewhat on the climatic conditions.

Ostriches are called "chicks" until six months old, or as long as they have their first crop of feathers. From then until one year old they are called "young birds," and from one to four years they are known as "plucking" or "feather" birds. It is difficult to determine the age of an ostrich when it is more than three and one-half years old.

Handling.

Young ostriches are usually kept in troops of twenty-five to fifty. When they are one year old, the males should be separated from the females. When they are three and one-half years old, the birds should be paired off, each pair or set of a

cock and two hens being placed in a separate enclosure, which, in case the birds are to graze on alfalfa or other green food, should be large enough to furnish them sufficient food. If they are fed on dry feed, the enclosure need only be large enough to allow plenty of exercise.

The usual way to fence an ostrich farm is to use a woven wire for the outside fences, about five and one-half feet high, and with meshes small enough to keep out wolves and dog . The fences used to divide the farm into small paddocks may be about five feet high and need not extend nearer than eighteen inches to the ground. Paddocks for chicks should be enclosed with woven wire, which should extend to the ground but need not be so high.

Ostriches are easily moved from one field to another by one person going ahead, calling them, and toling them on with grain, while another follows on a horse. The birds are very timid and do not like to be driven unless some one goes ahead of them. After ostriches are over one year old, no one should go among them without a brush or stick in hand, as at times they will want to fight, and a person going among them is liable to injury unless he has something with which to drive or frighten them away.

Feeding.

One of the very best feeds for ostriches is alfalfa. When pastured or fed on green alfalfa they are always healthy. Where good alfalfa pasture has been available, the birds bred in America have grown larger than those first imported. The writer has known troops of more than one hundred to be kept on alfalfa for three or four years without a death. Ostriches thrive well on any green forage, and they prefer the kind they have been taught to eat. Birds fed on hay, when turned out, often refuse to eat grass until they become very hungry.

For dry feed, alfalfa or clover hay cut up, mixed with bran and moistened, is excellent. An ostrich will consume about three pounds of hay and one pound of bran daily. It should have gravel and broken bone at all times. Ostriches may be fed any kind of grain—corn, wheat, barley, oats or peas. Some farmers feed a little grain while the birds are nesting. Ordinarily, however, if ostriches are in good flesh and have plenty of good, green feed they need no grain. If fed much grain, they are likely to become cross and hard to manage. They also become liable to digestive troubles. Good nutrition is most important, as the quality and production of feathers is thereby enhanced.

Although African writers assert that ostriches will live for years without water, American farmers find that they drink water freely every day if it is supplied to them.

Plucking. (Fig. 500.)

The ostrich is plucked the first time when six months old, and should be plucked about every eight months thereafter during its lifetime. The only feathers removed are those of the wing and the tail. The process of plucking consists in cutting the tail feathers and one row of the largest quill feathers in the wing with pruning shears, and drawing by hand those of the remaining two or three rows in the wing. Two months later the quills of the cut feathers may be removed.

At plucking time the ostriches are driven in from the pasture and placed in a small pen surrounded by a tight board fence five or six feet high. The plucking-box is about four feet high, twenty inches wide, and three and one-half feet long, open at one end and closed with a door at the other. An ostrich is caught and a hood placed over its head; an old black stocking makes a very satisfactory hood. The hooded bird is very easily handled. It is placed in the plucking-box with its head next to the closed door. The plucker stands behind the bird while removing the feathers. This is necessary, because the ostrich can kick or strike very hard, but it always strikes out in front and never behind, so that the plucker is perfectly safe if he stands in the rear.

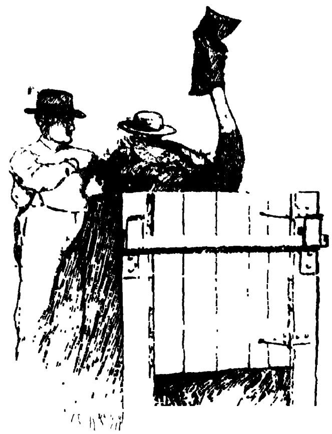


Fig. 500. Plucking an ostrich.

When removing the feathers from the ostrich, the pluckers usually tie in a bunch the feathers of each length as they are taken from each bird. When through plucking, the feathers are placed on a grading table, having enough compartments in it to hold all the grades and lengths of feathers, which are many. The size of each compartment is about four inches wide and four inches deep, and the length varies from four to thirty inches. In sorting, the feathers of the male are kept separate from those of the female. The former are the most valuable.

Grades of feathers and their value.

Manufacturers in this country usually request that the feathers be graded as nearly as possible as they are in the London market, where nearly all the feathers of the world are marketed. A London report shows the following classification: White, femina, bayocks, black, drabs, floss, spadones and boos, with numerous subdivisions or grades.

The value of the American feathers depends on the London market. In an American factory they will bring 15 per cent more than the London price, plus the freight charges. In January, 1907, "white primes" and "blood feathers"—the most valuable—sold in London for thirty pounds sterling ($146) per pound. It takes about ninety of the largest feathers to weigh a pound. The "white primes" and "blood feathers" are taken from the males, as well as most of the "white firsts," although occa-

sionally a female bird will have what the feather men call a "first white." The black feathers are plucked from the male birds and the drab from the females. "Spadones" are chick feathers of the first plucking. "Boos" are tail feathers. "Bayocks" (mixed colors) come mostly from the male birds. The shortest drab feathers, which are frequently used in making feather dusters, are worth about four dollars per pound. An average ostrich will yield one and one-half pounds of feathers annually, worth twenty to twenty-five dollars per pound.

The United States is one of the largest consumers of ostrich feathers in the world. America imports about two and a quarter million dollars' worth of raw or unmânufactured feathers annually, which is more than one-fourth of the world's supply. The feathers produced in America are fully as good as those coming from Africa, and it is said that they are broader and finer looking, although some manufacturers contend that they are not so strong and tough as the wild feathers.

Uses.

The value of the ostrich as a domestic bird depends on its production of feathers for ornamental purposes. It is hardly probable that the relations between supply and demand will so change as to make the ostrich more valuable as a source of food in the form of meat and eggs. The flesh of the domestic ostrich, however, is said to be much relished by those who have eaten it. The eggs are fine for making omelets and are good scrambled. One egg will make as much omelet as two and a half dozen hen's eggs. An ostrich has been known to produce over three hundred pounds of egg food in a year. There is no regular market for young birds or eggs except for farming purposes, the only sales being to persons who desire to engage in the ostrich business.

Longevity.

Nothing is positively known as to how long an ostrich will live. Some writers assert that it will live one hundred years. Ostriches which are known to have been in captivity for forty years, are still breeding and producing feathers. It is the experience of Arizona farmers that among birds having good nutritious green feed, deaths seldom occur except as the result of accident. A dog or other small animal will sometimes frighten an ostrich and cause it to run into the fence, which may result in a broken leg. When this happens, the bird may as well be killed, as few, if any, ever recover from such an injury. Ostriches are exceptionally free from disease.

Literature.

Mosenthal and Harting, Ostriches and Ostrich Farming (1887); Martin, Home Life on an Ostrich Farm (1891); Duncan, Report United States Department of Agriculture, 1888; Paul, Ostrich Farming in California, Cosmopolitan Magazine, Vol. XI, New York (1891); Newton, Dictionary of Birds, New York (1896), which contains numerous references.

PETS. Figs. 501–523.

By *C. H. Ellard.*

The subject of pets is of widespread interest and includes a large variety of animals. The most common and important of these in America are dogs, cats, rabbits, cavies or guinea pigs, mice, rats, squirrels, pigeons, bantams and cage-birds. The extent to which pets are kept is greatly increasing. The localities where they seem to be most numerous are about the manufacturing towns of New England and the middle Atlantic states, thinning out as the West is approached. Statistics indicate that there are more pets in the state of Pennsylvania than in any other state.

It is not the province of this Cyclopedia to discuss at length the subject of pets, as they are scarcely to be considered farm animals. For that reason, the accounts here given must be brief. Farm dogs are considered on pages 383–389; cats on pages 299–301; Belgian hares on pages 412–415, and pigeons and bantams in their agricultural relations in the following pages under *Poultry.*

Dogs.

The dog, since the earliest time, has been more or less a help to and companion of man. It has gradually become useful in many fields, and now is the most universally kept pet, with the exception, perhaps, of the canary and the cat. Hunting dogs were evidently the first to be used and trained by man. Of these, the setters, Pointer and spaniels are the breeds now recognized other than the hounds. These are all strong, speedy dogs, possessed of unusual intelligence in the work of the huntsman. There are three varieties of setters recognized today,—the English, the Irish and the Gordon; all are similar in shape, and differ chiefly in color.

The setters.—The *English setter* is a trim, strong, speedy dog, with rather long hair and with the feathering that characterizes the setter,—that is, a fringe of longer, rather wavy hair along his lower outline, his back being smooth. The English setter is usually black and white, or liver and white. The *Irish setter* is red, the only reason for calling him Irish seemingly being the color, although that kind of dog was used considerably by Irish landlords. The *Gordon setter* is a bit heavier than the others and is black and tan. Good specimens of these latter dogs are not very plentiful and are striking in appearance.

The spaniels embrace a number of different varieties, and to this type of dog the setters belong; in fact, the spaniels were known in early times as the setting spaniels. The *Cocker spaniel* is the most widely bred of all the varieties, and some very handsome specimens of it are seen in our large dog-shows. It comes black, red and parti-colored, and an occasional one of some other color appears. It was originally used for hunting small game but is now chiefly a house dog. The spaniel has a mellow, large, brown eye that is very expressive and rather an important characteristic, as is also the feathering of the legs, as in the setter. The *Field*

spaniel is of about the same style as the Cocker, and, indeed, is really a larger Cocker. It is longer, and hence appears lower, heavier built but not clumsy. This variety is not very widely bred in America, but there are a few studs of repute in England. The *Clumber spaniel* has most of the characteristics of the other spaniels, but the "stop," the indenture at the union of the forehead and muzzle, is deeper. The dog is shorter than the Field spaniel and larger than the Cocker. The *Irish Water spaniel* is a dog used by the water-fowl huntsman, and is a sturdy intelligent "retriever." Several studs are maintained in Canada, but few are bred in the United States and few are seen at the dog-shows. The dog is covered with a long, brown, slightly curling coat, of which there is not enough for his face and tail, both of which are practically bare. To these varieties may be added the more unusual *Sussex* and *Norfolk spaniels*, few of which are bred in America.

The Pointer and "*Retriever*" is the outcome of a need for a dog trained for wing shooting. It is more of a hound than a spaniel, and is rather common, especially in regions where there is much shooting. It is usually a straight, short-haired dog with a predominance of white, spotted and marked with black or liver.

The Chesapeake bay dog is bred for water shooting along the bay, the name of which it bears, and up into Ohio and along the Potomac. It is symmetrically built, with only moderate "feathering" as compared with the setter. It is strong, and of about the color of wet sedge-grass.

The Dalmatian or Coach-dog was, perhaps, originally a hound from Dalmatia, but most of the hound characteristics are gone in the modern Coach-dog. It is spotted with black on a white ground, and is peculiar and striking when ideally marked. It is a running dog, and hence is lightly but strongly built. Its endurance is sometimes wonderful. It is a stable dog, and is alert and discriminating. It should approximate fifty pounds in weight.


Fig. 501. Bulldog.

For the *Collie* and the *Sheep-dog* the reader is referred to the special articles on pages 383–389.

The bulldog (Fig. 501) originated in the brutal bull-baiting contests, in which the dogs were trained to pull down the bull by the ears. To do this, a heavy, tenacious brute was necessary. Later, the "nose-hold" was tried, and as it worked better than the "ear-hold," the dogs were trained for this. As a smaller dog of greater agility was necessary for the latter, the bulldog decreased in size. Bulldogs are particularly homely, with their huge, heavy head, broad shoulders, bow-legs, and the hind-quarters and loins a trifle higher than the shoulders. As a rule, these dogs are under-shot, and show their teeth more or less. They are renowned for their faithfulness, tenacity of hold and watchful care of property. They have been bred for a long time simply as a fancy dog, and a kink was bred in their tails to keep these down. The *French bulldog*, while not so lively and alert as the Boston, is a very popular house dog. It has a broad, square jaw and large, dark eye. It is seldom over twelve inches high and should be smaller than the Boston. It is usually of a darker brindle than the Boston, although the latter is now being shown in black and white. The French bulldogs are generally of uniform color. Their ears are erect. Recently they have enjoyed the enviable place at the crest of the wave of fashion in dogs.

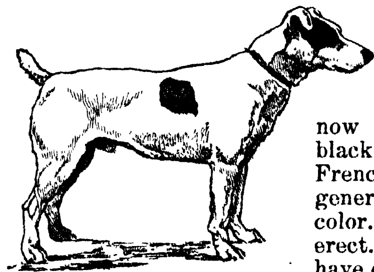


Fig. 502. Fox terrier.

The terriers were used for a long time for the hunting of foxes, badgers, rats and other small game and vermin. Of these, the little *Fox terrier* (Fig. 502) is the most popular. It was bred as early as 1802. It should show a predominance of white, marked with liver or black. The nose should be black, the skull flat, rather narrow and decreasing toward the eyes. The ears should be V-shaped and always have a forward fall, pointing toward the tapering muzzle. It should be over-shot slightly, but the teeth should come together with the upper ones just on the outside. The neck and body should be trim and muscular, without coarseness. The tail should be carried high but not over the back nor curled. The Fox terrier is a lively, active, intelligent dog, that makes an excellent watch-dog and companion. It is an indefatigable ratter and vermin exterminator. It is very widely bred. Recently there has been bred the *Wire-haired Fox terrier*. This is similar in all respects, except the coat, to the smooth-haired variety. In all probability it was the original Fox terrier. The *Airedale terrier* was probably produced by the crossing of the grizzle and tan terriers with other dogs of the vicinity in

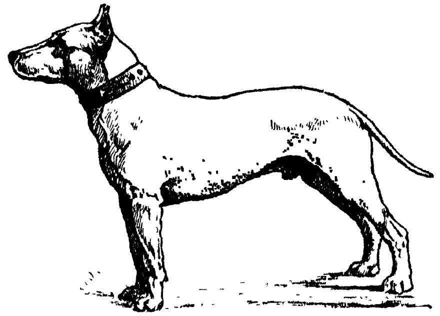


Fig. 503. Bull terrier.

Yorkshire. It has a stronger jaw and muzzle than the Fox terrier and the ears are wider. The cross of the bulldog on the terriers gave the *Bull terrier*. (Fig. 503.) It was first noted as a distinct breed about

1820. It has a wide brisket, rather long, very muscular jaw and a rather round head, an appearance due largely to the huge jaw muscles. It grows to very good size and is usually heavily built, but not in the least awkward. It possesses many of the traits of the bulldog, and the activity of the terrier tribe. With these terriers, the old *Black-and-tan terrier*, the *Bedlington terrier* and the *Irish terrier* might be classed. The *Skye terrier* is a rather large dog, weighing over twenty pounds and covered with long hair of a bluish tint. Its ears are either erect or fallen, the former being a bit more correct. It is a long, low dog, and a great favorite as a house pet with those who can care for its coat. The *Scottish terrier* is a long, low grizzly little dog of very ancient lineage, but only very recently seen in America. It is prick-eared, nine to twelve inches

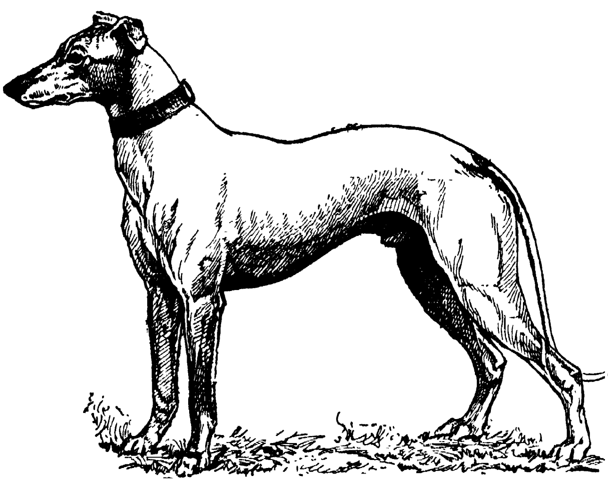


Fig. 504. Greyhound.

high, and gives the impression of an oddity in dogdom. It is an active hunter of rodents and other vermin. The *Welsh terrier* is medium sized, being between the Irish and the Fox terriers. It is usually black and tan, but not necessarily. The *Boston terrier* is essentially an American dog, having been produced, it is said, by the crossing of the small bulldog and the Bull terrier, and displaying the best qualities of each. The skull should be square, practically the same width at the ears and at the eyes. The nose should be black and the face marked with a white blaze ; a white collar and four white feet are ideal, but color is not an essential feature. The color is usually one of the three brindles on the remainder of the body. The eyes, ears and back are covered with golden seal or mahogany brindle. Occasionally a black or a black brindle is seen, and less often a fawn color with a brown nose. This is, perhaps, the most popular dog of the day, sharing honors with the French bulldog. The *Maltese terriers* are small, pure white dogs with drop ears, like some varieties of the Skye. Their coat is long, straight and silky, reaching to the ground. They are always small and never should exceed the twelve-pound limit set for "toys." The *Yorkshire terrier* is a pigmy in the terrier family, produced from the same general crossing that gave the English fanciers the Airedale. Its coat is long, straight and even, of a bright steel-blue color, with tan markings. The Yorkshire is raised as a pet to a large extent abroad. Not a very large number are seen in this country, but some are in evidence.

The Great Dane is a strong, speedy dog, with more of the litheness of the Greyhound than heaviness of the Mastiff. The minimum size is thirty inches and one hundred and twenty pounds for males, and two inches and twenty pounds less for females. As much greater height as possible, retaining type, is sought by breeders. Great Danes are of several colors, the gray, red, black or patched being the most desired, although an occasional fawn or white one is seen.

The Mastiff is one of the very oldest types of dogs. It is massive, combining great courage and docility, and built after the bulldog type. The nose is blunt and square, making a muzzle about one-fourth the total length of the head. It is not nearly so popular as formerly.

The St. Bernard in America is a purely fancy dog, different in type from that used at the Hospice. It is a symmetrical, massive dog, with a square muzzle, black nose and usually a white blaze, The coat is long and not so thick as that of the dog used at the Hospice.

The Newfoundland dog has very largely disappeared from view. It originated in Newfoundland. It is black, at least twenty inches high, and is a water dog. The coat is thick and long, the head slightly domed, with rather a pronounced "stop."

The hound family includes a number of dogs of peculiar development, built to run and pull down the quarry. These dogs follow mostly by scent, although in the Greyhound and some others, sight seems often to play an important part. The *Greyhounds* (Fig. 504) are slender, strong dogs, with a muscular but graceful body, long, tapering muzzle, lined with the sharpest teeth and manned with strong jaw muscles. They are a very early type of dog. The *Wolfhound* is much like the Greyhound in build, the head being a little longer and narrower and showing more of the Roman nose. It stands twenty-eight to thirty-one inches high. The *Russian Deerhound* is the most common of this family of dogs. There is also the *Irish* (now being promoted by Irish fanciers) and the *Scotch Deerhounds*. The latter is rare in America. These have long shaggy coats and are heavier than the Greyhound. The *Whippet* is closely related to the Greyhound, and is, indeed, a small Greyhound in type. It is trained for racing. These dogs are lined up and started like race horses, and without rider or other incentive on the course, fairly fly to the finish. In the *Bloodhound* we have the exaggerated type of hound, with its peculiar accuracy of scent, its hanging lip and dewlap, and the falling under-eyelid, the pendulous ears and strong, thick-set body on rather short legs. The head is the most important part of the show Bloodhound. As a watch-dog, it has a reputation for vigilance and discrimination. The *Foxhound* is perhaps

the commonest of the hounds in America, and has the misfortune of having no very distinctive type. It is kept mostly in packs on southern estates, and is used for the hunt either of the anise bag or of a real "Reynard." There are two breeds, known as the English and the American, but as the type is not distinctive, differentiation is difficult. The Foxhound ranges from twenty-one to twenty-four inches high, and should not weigh more than sixty pounds. The *Beaglehound* is the smallest of the hound family, excepting the dwarf Basset and Dachs. Beagles are raised and trained in large numbers in various parts of America, where they are also often called rabbit hounds. They are distinct in type, with a fairly long, slightly domed skull. They come in several colors, in which white is a common admixture. The *Italian Greyhound* is a small golden fawn dog of the same general character as the larger dog, but of even greater symmetry with a prancing action of limb that carries with it the impression of unusual grace.

The Poodles, with their curly and corded "locks," form a family of dogs very tractable indeed, and are invariably the mainstay of exhibitors of trained dogs. They are chiefly bred as house-dogs or for fancy, and in either case always apparently come up to the expectations of those who fancy this type of dog.

The Pomeranians are, perhaps, a development of the hounds of Italy or Greece. They were also known as the "Spitz." They are a fad and win many prizes at shows. The larger specimens are about fifteen to twenty inches high, and the small ones not more than ten inches and often less. They have a long fine coat and lots of it except on the face, where the hair is short. The tail is well covered with long hair and is usually curled. They have a quick, fox-like appearance and manner, that often grows into a snappish disposition.

The Pug is a dog of oriental origin, from all that can be gathered, and is useful only as a pet. It is a square little dog, with a large proportion of individuality.

The Griffon, with wiry coat and rough head, the *King Charles*, with its out-of-proportion head, short face and large eyes, but pretty manner, the *Blenheim* and *Pekinese*, are all ladies' dogs; and while pets to which many a woman devotes her energies, they are not possessed of any very remarkable gifts of intelligence nor are they a very safe dog when children are about.

Rabbits.

The domestic rabbit is bred in many varieties in America. All varieties except the Imperial and the Silver-brown are represented among the hutches of the fanciers in the American Fur Fanciers' Association. Each variety has a type of its own, distinctive in shape, carriage, size, and often in color.

The raising of pet stock brings fair monetary returns. While there is but small profit in raising rabbits for the foreign element's market, and cavies and mice for the bacteriological laboratories, there is much more in the raising of good pure-bred fancy stock; and few fanciers with an exhibition record and a reputation for "square dealing," fail to pay their feed bills and make a little profit. Most fanciers combine the two practices, disposing of the poor specimens or "culls" to the marketman or dealer at market price and selling the better specimens to new fanciers or others wishing good standard-bred stock.

Fig. 505. A prize Angora doe. "Snowball."

Belgian hare rabbit.—This was the most popular of the rabbit family. It is discussed at length on pages 412–415, and will not be considered here.

Angora.—The aristocratic Angora (Figs. 505, 506) is, perhaps, second in popular favor and fancy. It is one of the most attractive and handsome varieties of the rabbit family. These rabbits are grown in France for the wool they produce, the length and fineness of texture in reality taking their coats out of the fur class. The Angora wool used for babies' caps is made from the wool gathered from the nests of these rabbits, for which cotton wool is substituted. France has regular farms devoted to this enterprise. No similiar use is made of the Angora rabbit in this country.

The Angora should be rather large, with its head and body almost obliterated in outline by the woolly coat. The feet and legs are completely hidden, and good specimens show a heavy coat of wool all over. The chest develops a huge fluff or apron, into which the rabbit delights to sink its chin, and as the fur on its cheeks and neck comes forward about the face, it loses all rabbit appearance except for the ears. These should be short, wide and covered with fur. The tips are usually topped by little tufts of wool that give them the appearance of being tasseled. The Angoras are bred in uniform and broken color. Of the former, the white or albinos seem to be the most nearly perfected so far, usually producing larger coats and larger specimens. There are also blues, fawns, blacks and yellows.

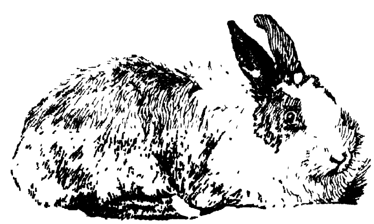


Fig. 506. Angora doe with Dutch markings.

Flemish Giant.—Next to the Belgian hare rab-

bit, the commercial spirit would place the Flemish Giant (Fig. 507); in fact, its place is before the Belgian hare in the estimation of many persons. As its name implies, it is the giant of the race. It was introduced into England by the present secretary of the National Flemish Giant Club of that country, in the early "eighties." It was then a huge, sandy gray rabbit, but today, a dark steel gray is the proper color and sandiness is a disqualifying mark. It was brought to America during the Belgian hare craze, as were several other types, and much crossing was done to increase the size of the Belgian.

The Flemish should be a dark steel-gray, with as even and deep a color over all parts of the body as

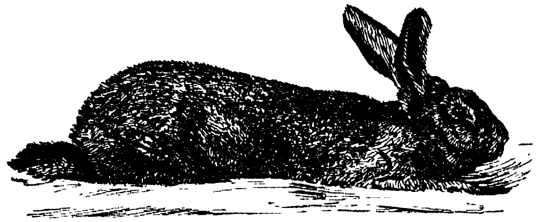


Fig. 507. Young Flemish Giant doe, typical for shape and color. A sixteen-pound specimen.

possible. The under-body and under-tail are exceptions to this. They should be white or at least of a light slate-color. The back, sides and chest should all be wavily ticked, but not so much so as to be smudgy. They should be bright in color, but not light gray nor sandy or brownish. In almost all specimens a little brownish patch appears at the neck, just back of the ears. The feet too often show a little inclination to ruddiness. They often reach sixteen and occasionally twenty pounds in weight.

The Dutch rabbit (Fig. 508) is one of the oldest of all the varieties. It has changed much in type, but the present-day Dutch has the same general markings as the original, those of the Dutch Belted cattle, approximately. The eye and ear are included in a patch of color on the cheek, while a V-shaped white patch should separate these between the eyes, and in a hair-line between the ears join the white collar that includes the fore-feet, chest and neck. Just back of this is the saddle, of the same color as the cheeks, and covering the rest of the body except the hocks, which should also be white. These and the saddle should be level all around. To reach the ideal in the markings of the Dutch rabbit is no mean task, and, abroad, twenty pounds is not thought exorbitant for a nearly perfect one. It is bred extensively by farmers' boys throughout the country, in a more or less haphazard way.

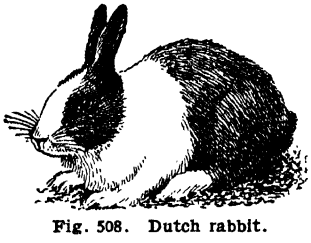


Fig. 508. Dutch rabbit.

The Dutch rabbit was introduced with the Belgians from abroad, when the latter were used as foster mothers to rear the young of other rabbits whose quality is not discernable at birth. The Dutch rabbit is growing rapidly in popularity.

The English rabbit (Fig. 509) or, as it was known at first, the "spotted" rabbit, is the Dalmatian of the rabbit fancy. It has what is known as the "butterfly" snout, a nose marking which, viewed directly in front, looks like a spreading butterfly. The back is to have an unbroken herring-bone marking following the spine. The sides should be spotted, running from the shoulders to the thighs and widening, but each spot clear and distinct. The cheek should have a spot and the eye a circle of color with a spot just clear of it. The ears should be the same color as the spots.

Fig. 509. English rabbit.

These rabbits come in black, blue and tortoise, the black usually presenting the most effective and pleasing combination with the white, which the rest of the fur other than the spots should be. There are three studs of these rabbits in this country, from which they have spread rapidly. All the originals were imported within the last decade.

The Himalayan rabbit (Fig. 510) has been fifty years or so in the making. It is probable that from black or silver-gray rabbits an albino has sprung with colored extremities. This has been inbred and developed until we have our present-day pretty little rabbit that, it is said, furnishes a great deal of artificial ermine. The entire body is white, eyes pink, but the ears, nose, feet and tail are nearly black. The statement is often made that it came from the Himalayan mountains, but the evidence seems rather to support the origin in the breeders' art. It should be compact, with fine-cut limbs, but not chubby like the Dutch nor yet racy like the Belgian. Particular care has to be used in the amount of light admitted to the hutches. It does not develop its full color in the dark, and direct sunlight fades the black extremities. It must also be kept carefully dry, as accumulation of moisture and manure soon fades the leg color.

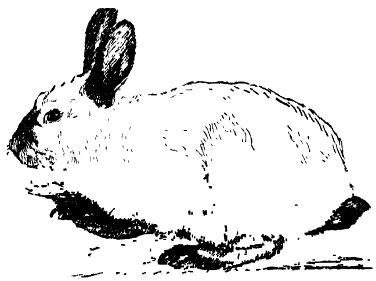


Fig. 510. A Himalayan rabbit. Winner of special prizes, Madison Square Garden, 1907

The Lop-eared rabbit was one of the earliest of all fancy rabbits. There are perhaps a half-dozen breeders of this variety in America. The main desire of the fancier of "Lops" is to get great length of ears combined with breadth and thick, tough, leathery substance. The ears grow very rapidly, and in three or four months nearly reach

their maximum, although they grow slightly until a year old. It has been raised on the island of Jersey to measure thirty-one inches across the head from tip to tip of ears. The greatest width seen in this country is about twenty-one or twenty-two inches. For the most part it lacks in substance and width as well as in length. The "Lop" is a big, heavy-boned animal, with rather an awkward, unwieldy, mulish appearance.

The Silver-grey rabbit is as old, if not older than the "Lop." It has been raised in England for its pelt for a period of time covering several generations. The fur is close and of the sheen and brilliancy of silver. The coat is an admixture of white and black hair, with an even and uniform ticking all over the animal. One of the prime requisites of a good Silver-grey rabbit is the evenness of his coat, which should show no streaks darker or lighter than the rest of the body. It is a chunky, compact little rabbit. It is bred in this country in grey and fawn.

The Tan rabbit is the product of the breeders' art, devoted to developing a little wild hedgerow rabbit into one of the handsomest of the race. It is either black or blue in body color (by blue is meant a grey-blue, a cadet-blue, sometimes called maltese in cats, although the latter is darker than the blue in rabbits). The eyes are surrounded with circles of rich tan, as are the nostrils. The outer and inner margins of the ears, the under jaw or jowl, the chest and inner parts of the legs, the belly line at the side, should all be of rich tan color; and a handsome combination of color it makes. The type is cobby and should be small. There are but few studs of Tan rabbits in America worthy the name. There are, however, some good Tans bred in America. When it is at all near the ideal, it is one of the prettiest of the rabbit family.

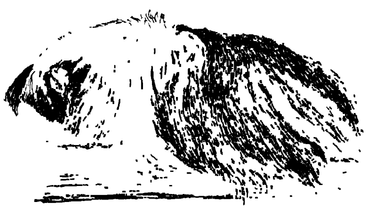


Fig. 511. Broken color Peruvian cavy, showing "sweep" and mane.

The Polish rabbit, often miscalled the English or common rabbit, is a sprightly, bounding, little ball of fur. It is the toy of the rabbit family and the smaller it can be bred the greater its value. It differs from the common rabbit in other particulars than size. The ears should be very short and very closely set, so that when turned back the flanges meet. The eyes should be red, not pink. It should have a very small ball-like body, with limbs as delicate and fine-boned as possible. These rabbits are bred almost wholly as pets and have of late been enjoying a very extensive "boom" in England. There are but two studs known in this country, and both are in New York. The Polish rabbit was exhibited at Madison Square Garden for the first time in December, 1907.

Imperial rabbit.—To the above varieties might be added the Imperial rabbit, lately introduced in the English fancy, but not bred in America at all so far as known. It is all blue and of the same type as the Tans in general, lacking the markings, of course.

Cavy.

The cavy is a little pet more commonly known by its misnomer, guinea pig. It was introduced into England, it is said, by some sailors on their return from a South American voyage, where they found the natives making a domestic pet of it. The naturalist gives us a list of several varieties of this species found in South America. The domestic cavy has been kept and bred in England, France and now in Germany and America, to a very large extent, as a pet and as a hobby for those interested in stock-breeding.

Fig. 512. Abyssinian cavy.

There are three main varieties recognized by the standards of the various associations in each country. These are the Peruvian or long-haired cavy, the Abyssinian or rough-coated cavy, and the smooth or English cavy. To these might be added the Angora, or what is now really a Peruvian sport and called a "silkey" or pseudo-Angora. The real Angora cavy, according to French authorities, has disappeared. The geographical names used have no significance as to origin in any of these varieties.

The Peruvian cavy (Fig. 511) is said to be the result of a cross of the Angora on the Abyssinian, and its general type bears this out to a certain degree. It has an exceeding long coat, completely obliterating the general contour of the body. The young show more or less rough rosettes in their coats, but as these lengthen with age the rough spots are overwhelmed with the long silky tresses. The fancier divides the coat into three main parts, viz., the "sweep" or hair over the loins and haunches; the mane, that on the shoulders; and the head furnishing, which includes the parts that grow from the forward part of the shoulders, the neck, the forehead and about the face. The latter should completely hide the head and face when in condition, a quality much sought by the breeder of this variety. An individual possessing it scores highly in competition. The mane should be long, thick and heavy, and often is even harder to secure than head furnishing. The sweep is the easiest point in which to excel. In caring for the coats of these pets, one has to be careful to have no litter likely to tangle

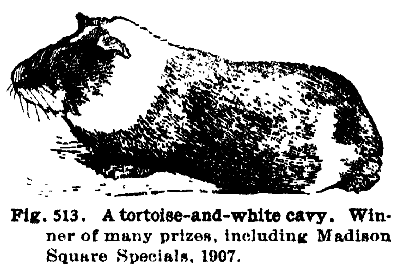


Fig. 513. A tortoise-and-white cavy. Winner of many prizes, including Madison Square Specials, 1907.

the coat. When the coats get so long as to drag along the floor of the hutch they must be rolled up and tied on papers to keep them from wearing off.

The Abyssinian cavy (Fig. 512) is the rough-coated member of his tribe. He should present a coat radiating from centers all over the body; the greater the number of radiating centers the more valuable the specimen. The coat should be harsh and wiry, and so specimens are bred where the average temperature is cool. This cavy needs no especial attention other than cleaning and feeding, except to give the coat an occasional brushing to keep the rosetting as distinct as possible. It is bred in broken and uniform colors, the coat often taking the pattern of the Dutch marking; and many handsome tortoise-colored ones are bred.

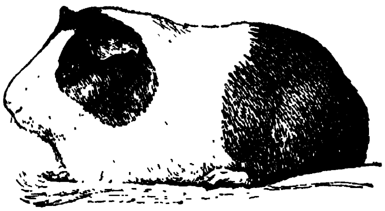


Fig. 514. Black Dutch cavy.

The smooth or English cavies are bred in a variety of colors, both uniform and broken. The species shows a strong tendency to a broken-colored coat, and it was only by persistent line-breeding that uniform coats were secured. The first good ones were the red, then black appeared, and now we have cream, fawn, both golden and silver, agouti, white, chocolate, and the near future will probably see a blue. These have all been produced by persistent work on the part of fanciers.

Mice and rats.

Mice are, perhaps, the smallest pets we have and also the ones with the most enemies. These little fellows are fast becoming favorites. They are bred to a very great extent for biological research. The period of gestation is twenty-one days and the young grow very quickly, breeding when they are eight to twelve weeks old. They are bred in a large variety of colors, from the pink-eyed white to the pink-eyed silver. There are black-eyed white, yellow, fawn, agouti, tan, chocolate, red, black, Dutch-marked, broken-colored, and oftimes a remarkably variegated type.

Rats should be classed with the mice, although they are not bred so widely nor are they so popular. There are several varieties besides the white rat, but they are not nearly so various in their range of colors as the mice. Black rats, the so-called Japanese rats, white with black face, shoulders and a black stripe following the spine to the tail, brown and Irish, are about the extent of present varieties.

Squirrels.

Squirrels can hardly be considered domestic pets as yet, usually being captured young and not bred in captivity. The pets acquired from the wilds must needs be gradually accustomed to their new surroundings and the confinement. Squirrels and similar animals should have quarters calculated to simulate their natural environment as nearly as possible.

Pigeons. [See article on pigeons and squabs under *Poultry.*]

It is fairly well demonstrated that the originator of all domestic pigeons is the little rocky pigeon common from Norway to India. From it the various types of wild and domestic pigeons have been developed, influenced largely by environment, but more by the mind and hand of man in selection and breeding. Pigeons, perhaps, of all domestic animals have the longest and most brilliant history. Darwin asserts that pigeons have been domesticated for 5,000 years. The actual records are available to show their domestication prior to 1600. In 1676, a Latin book on "Ornithologie," by Willoughby, mentions several varieties of pigeons. In 1678, this was published in English. In it seventeen varieties were enumerated, some of which are still with us, giving them a straight English history of over two centuries. This early writing was followed by John Moore's "Columbarium or Pigeon House" in 1735, in which many of the modern varieties are described. From then to the present, successive treatises have appeared, so that the pigeon has not been neglected.

The amateur pigeon men in America are well organized and each variety has its own club, to which most of the reliable breeders of the variety belong. Every poultry-show includes pigeons as part of its exhibit.

The Pouter (Fig. 515) is usually the leader. Its history dates back to before the beginning of the seventeenth century. It is characterized by the peculiarity of inflating its crop until it is almost "out of sight," except for crop and legs. In 1735,

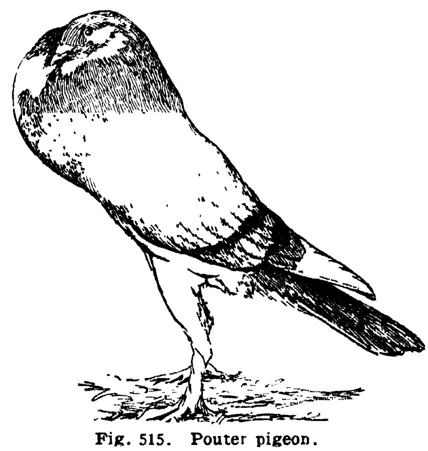


Fig. 515. Pouter pigeon.

Moore speaks of Pouters as having a twenty-inch body, although the average was seventeen to eighteen inches, and legs nearly seven inches long, the average length then being six and one-half to six and three-fourth inches. These pigeons now have feathered legs, and are, perhaps, not so popular as they were. There is a smaller variety known as *Pigmy Pouter* that has the same characteristic of inflating itself.

The Carriers were first described by Willoughby in 1677. These pigeons originally were brought from Persia, and are remarkable for the length and strength of beak and the carunculation of bare skin about its base and about their eyes. They are rather monstrous-looking birds. They are bred by a number of fanciers here and abroad, and are purely fancy birds, and not the pigeons used to transmit messages.

Barb.—Closely allied to the Carrier is the Barb, a pigeon of the same general development, eye, cere and wattle, but whose beak is short and the wattle not so exaggerated. This variety and the Carrier are probably from the same original stock, the Barb being in all probability the older type, and from it the long-beak bird has developed. The pictures of Aldronvandi (1600, about) seem to represent the Barb rather than the Carrier.

The Dragoon is akin to the Carrier, and it is said was produced by judicious crossing on the Carrier and then back-breeding to the "Horseman" of the earlier times. It is a stocky bird, being shorter in body and heavier than the Carrier, and with a very characteristic carriage from which the name was derived.

The Fantail seems to trace its history back to the Sanskrit days in India, where it was kept before 1600. This variety is to many the most attractive of all the varieties. The wide-spreading tail, whose feather ends are plumed like "my lady's" fan, the proud carriage, with the head touching the overshadowing tail, and crop and chest extended, give it a very fascinating appearance. It is bred to as large an extent as almost any other variety. It comes in various solid or uniform colors, as black, white, yellow and red.

Hooded Jacobin.—With the Fantails may be classed the hooded Jacobin. These pigeons existed before 1600, but were not nearly so well developed as today, nor was the head white as in the modern type. These pigeons wear a ruff about the neck and head, often concealing the head completely. They are one of the most popular of all breeds. They are medium in size, with a long, slender body, and the frill or "boa" covers the neck and head to the eyes. The combination of color with this odd neck-dressing makes a very pretty little bird.

The Turbits were probably the old cortbeck of the early writers, and appear for the first time, as we know them, described by Willoughby. They are very pretty birds, with short, rather curved beaks, and have a topknot or crest at the back of the head. The head is round and rather broad. Looking down on it from above, the beak should be too short to be seen, or at most, only just seen. The gullet is deep. Down the front the Turbit wears a frill of feathers turned so as to resemble the old-fashioned frill our grandfathers used in place of a cravat. These birds are bred in white with wing colors alone, no uniform colored turbits having yet appeared that can be classed with the winged birds. These are rather expensive pigeons; good ones are seldom priced under five dollars, and prize-winners often sell at fifty dollars and more.

Oriental Frills, Saturettes, Blondenettes.—These beautiful little pigeons, with their general trimness and Turbit type, and their beautifully colored plumage, are the product of the modern fancier with his ready adaption of peculiar types to his sense of the beautiful.

Owl pigeons are of this same type, a trifle smaller, with a jaunty air and carriage, and usually in uniform colors. Their breeders make every effort to bring them near, at least in head and beak, to the type of the owl.

The Tumblers were known in India before 1600, although it was not until after 1687 that they made their appearance in Europe, when Willoughby describes a "football pigeon." The peculiar flight of these birds has been the subject of remark by almost every natural history writer of the last two centuries. While this tumbling flight is retained or augmented by the selection of the fancier, the characters of the face have been changed, and we now have the Long- and Short-faced Tumblers as well as the "Muffed" and "Parlor" Tumblers.

The Runts, Scanderoons and *Hen pigeons* are large birds. The first carry the tail in the usual manner, slightly slanted downward, while the Scanderoon has a very short, narrow and elevated tail. The Hen pigeon, so-called, seems to be very closely allied to these as far as general appearance is concerned.

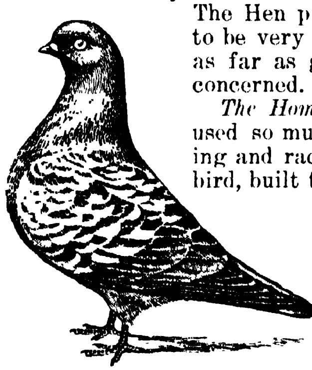


Fig. 516.
Dark mottle tippler cock.

The Homer or *Homing pigeon*, used so much for message-carrying and racing, is a stout, stocky bird, built to fly long and swiftly. It is trained by short-distance flights, gradually being increased up to several hundred miles. Its fanciers are organized into an association, which regulates carefully the records of these racing flights. This variety has been much exploited for squab-raising.

The Archangels, Swallows, Helmets, Magpies, Spots and *Nuns* are pigeons in which the greatest distinguishing features are color and marking. Some of these colored varieties are "booted," that is, wear feathers on their legs like the Pouters, while others are clean-legged. The Archangels are a rich copper-bronze on the head, neck and breast. This shades off in the wings and rump to a bronze-black, with a blue-black tail. The Nuns are smaller than their aboriginal ancestor, but have retained for a very long time their characteristic markings, and are probably the originals of the other similarly marked varieties. They are very pretty with their symmetrical markings on head, wing and tail. The feathers on these parts of the bird are black or red, the remainder of the feathers being white. Spots belong with the Nuns, and differ only in carrying a spot in the forehead and tail of the same color, the remainder of the body being white. Swallows are a more recent breed, although bred

before 1795 in Germany. They are now bred with the wings colored and the legs feathered. The beak is a trifle longer than that of the wild pigeon, and they carry a larger body, but yet do not appear so bulky. The Magpies and Helmets should be included with the Nuns, Spots and Swallows. The former is bred to imitate the bird whose name it bears, in color particularly. The Helmet is a Nun whose color is confined to the top of its head like a helmet.

The Trumpeters and *Laughers* are characterized by their peculiar coo, and the former by the odd curling feathers at the beak, curving forward over its base. Their legs are excessively feathered.

The Frill-Backs have a peculiar curl backward or upward to their feathers, especially on the wing coverts.

The Cumulets or "*High-flyers*," as they are called, are described best by their second name. With them and the Tipplers and the Homers, the fancier can easily use the barn-loft for housing. These varieties delight in being up in the air, and are built for flight.

Cage-birds.

The number of cage-birds kept as pets is very large. Many common wild birds have been domesticated as will be pointed out below. All of the birds here mentioned are domesticated and found in aviaries.

The canaries usually kept in America were formerly bred for the most part in Germany or England, but now a large number are bred here, especially the fancier ones. These birds are about five and a half inches long, with rather stout, compact bodies, and vary in color from a very light mealy yellow to nearly a clear green. Some of these birds have crests, but this is rather an unusual addition. Their voices are mellow and play over a long range of notes. The *St. Andreasburg canary* is bred in the same district in Germany as the other Hartz birds. It is a small bird of about the same colors as the others, but with a song of a greater variety of notes than the regular Hartz canary. These canaries are usually a light yellow or yellow and green, and are one of the smallest varieties, being four to five inches long. The *English canaries* are much larger and of higher color, and sing louder than the German canaries. They have many odd wild-bird notes. The *Manchesters* are the largest canaries. Some of them have plain heads and others have thick, full crests falling over the eyes. The *Norwich canary* (Fig. 517) is not so large as the Manchester, but has higher colors, — deep gold, both clear and mottled; odd cinnamon colors are also popular. The *Red canary* is secured by breeding from the gold or gold and green colors, and feeding for color during molt. *Gold Spangled Lizard canaries* have bright gold-capped heads and continuous lines of spangles from the neck down the back. Each spangle is decided, its clear gold edging and olive-green center being distinct and regular. The *Silver Spangled* are marked exactly like the gold, having silver-colored spangles where the others have gold. The *Goldfinch canary*, or *canary mule*, is secured by breeding a male goldfinch to a light clear yellow hen, which has descended from several generations of clear yellow hens. It is a free singer, with enough of the goldfinch traits to be pert and gay. It is a very beautiful bird. Other mules are secured by mating the female canary with the linnet, bullfinch, siskin and other finches.

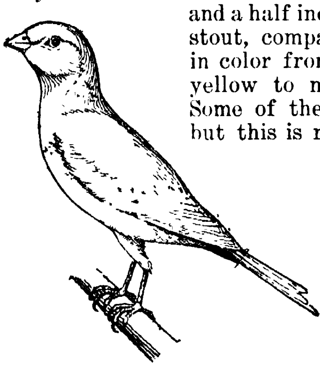


Fig. 517. Norwich canary.

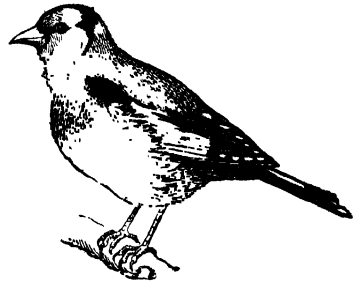


Fig. 518. Goldfinch.

Goldfinch.—The true goldfinch (Fig. 518) is one of the most delightful cage-birds, both for its beauty and for its song. It is very easily tamed. There are many varieties, shown by the difference in markings or color of the plumage. The most highly prized is the Scarlet-headed or Crimson, which has the entire head colored in scarlet or crimson. The White-breasted Cheveral or King goldfinch has a pure white breast and a clear white ring around the neck. The pure white is also highly prized. The goldfinch is found throughout Europe, and when caged sings throughout the year with the exception of the molting season.

The linnet (Fig. 519), either gray or brown, is a beautiful songster, and is generally kept throughout Europe. It is of hardy constitution and easily domesticated. There is scarcely any bird that puts on so many different dresses in the course of its life as the linnet. The linnet male will sometimes mate with the canary, but the males are not so beautiful as those of the canary and the goldfinch.

The chaffinch is one of the many European song birds, and should be generally kept for its sweet song and for its sleek plumage. It is extremely docile and can be easily tamed.

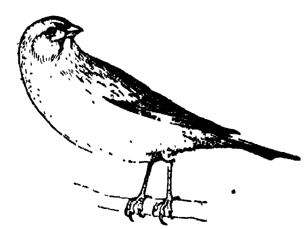


Fig. 519. Linnet.

The nightingale (Fig. 520) is decidedly the most melodious of all singing birds, and when caged and well treated will sing for six or eight months during the year. Improper feeding with other causes have seemed to render it impossible in many cases to keep this bird more than a few months. The nightingale is a very hearty eater.

The black cap, sometimes called the mock night-

ingale, is a delightful singer whose song is heard the year round except at the molting season.

The skylark comes from all parts of Europe. It has a most peculiar manner of flying, the movement being upward in a perpendicular line. After leaving its grassy nest, it begins its song, which it continues unceasingly until nearly out of sight; then it descends in like manner, still singing until within a short distance of the nest. The skylark can readily imitate the songs of other birds and learn tunes. In confinement it sings during half the year.

The wood lark resembles the skylark in color, but is smaller. It perches on branches, but like the skylark builds its nest on the ground. This bird is more easily tamed than the skylark and is happier in captivity.

The song thrush is a melodious singer, singing only during the spring in the wild state, but with careful treatment and good caging will sing eight or nine months of the year. The male and female are very similar in color, the female being the smaller. The male has great imitative powers and will readily learn tunes played on wind instruments or whistled to him.

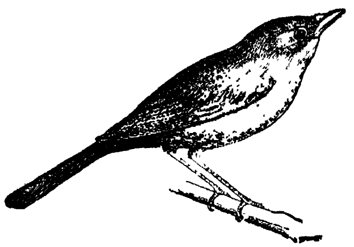


Fig. 520. Nightingale.

The blackbird, whose plumage is a pure velvety black with an orange-yellow bill, is a fine songster. His notes, although not so various as those of a thrush, are of a more flute-like tone. He has the ability to imitate airs that are whistled to him. He also learns to imitate the songs of other birds and in his wild state often mimics them.

The starling has a natural song that is rather poor, but it has a good memory and will learn to repeat airs that are played to it. It also learns to pronounce words distinctly or imitate any sounds repeatedly heard. It becomes very tame and can be let out of its cage to walk about the room.

The talking minor or *musical grakle* is a good talking bird and can whistle in sweet, full tones any song that may be taught it. It is about the size of a dove. The beak, feet and legs are orange-colored. The prevailing color of the plumage is a glossy black, tinged with purple, violet and green, according to the light in which it is viewed. It is a native of the East Indies. As a talking bird, the minor is unsurpassed. It speaks plainly and can retain a large number of words.

The bullfinch has no natural song but has the ability to imitate with great accuracy almost any air that is whistled or played to it on an instrument. In Germany, particularly in Hesse and Saxony, large numbers of these birds are taught to pipe popular or classical airs.

Troopial.—The South American troopial has a beautiful rich plumage and looks very much like our American golden robin or Baltimore oriole, the chief difference being that he is much larger and the orange of the body is more of a yellow. Few birds have a natural song at once so sweet and powerful, and none has a nicer ear or a more retentive memory.

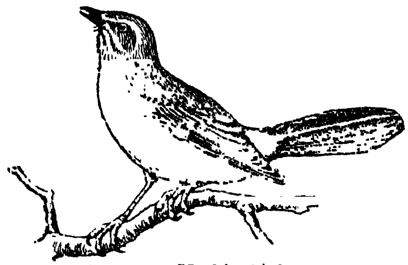


Fig. 521. Mockingbird.

The Brazilian cardinal is one of the beautiful whistling birds of the tropics. The back is dark gray; the quill-feathers of the wings are a darker shade of the same color, and the tail is nearly black; the head, crest, cheeks and throat are bright red, of an orange hue, deepest on the chest, where it ends in a point; the lower part of the body is grayish white, and the feet and legs are black; the strong beak is dusky gray; the crest is pointed like that of the Virginia nightingale and is raised and depressed at pleasure. The brilliant scarlet head forms a beautiful contrast to the snowy-white of the body.

The Java sparrow takes its name from the Java islands, where it abounds. Its chief recommendation is the great neatness of the plumage, the glossy black head, clear white cheeks and delicate rose-colored bill. The body is an ashen gray, the plumage being so neat and smooth that the feathers all seem to fit into one another. It can be taught a variety of tricks, perhaps more than any other caged bird.

The American mockingbird. (Fig. 521.) — This songster unites in himself all the excellences to a greater extent than any other living bird. The songs of other birds, the rattling and creaking of gates and swinging sign-boards, the cries of puppies and the katydid, and all other familiar sounds are possible with the mockingbird. It is a general favorite.

The Virginia nightingale (Fig. 522), *or Virginia redbird*, sometimes called the cardinal, is a native of the southern states, and is one of the handsomest birds of the New World. The color is a brilliant red, with the exception of the part around the beak, which is black; the wings are darker than the body color. The head is ornamented with a crest, which the bird can raise or depress, and which gives it a commanding appearance. It has a very pleasing song or whistle.

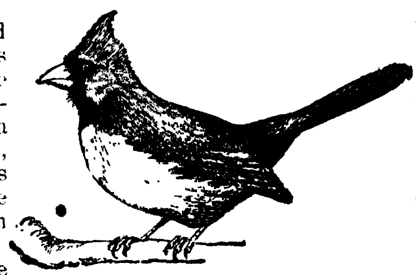


Fig. 522. Virginia nightingale or cardinal grosbeak.

The Red linnet is a beautiful singer or whistler and should be kept as universally as the canary. It sings all year round, with the exception of the molting season, and in confinement becomes tame.

The American yellowbird, or what is really the *American goldfinch*, is a beautiful lemon-colored bird with a black cap and white wings. It is a universal favorite. The song has a brisk, cheerful ring, although perhaps deficient in variety.

The nonpareil, as the name indicates, is without an equal. It has been called by many the "painted finch" or "painted bunting." It has a violet head and neck, a red circle around the eyes, the iris, beak and feet brown, the upper part of the back, throat, chest, and whole under part of the body as well as the upper tail coverts bright red; the wing coverts are green, the quills reddish brown tinged with green, and the tail reddish brown. It is about the size of an English robin and resembles that bird in many ways.

The Japanese robin.—"The head of the robin is bronze-green, beak yellow, body the color of a mourning dove, eyes black with a circlet of white, throat ecru tint of yellow shading on the breast into orange, wing-feathers black with parti-colored stripes of gold and white, and tail feathers glossy black barred with white." In size, the bird is similar to a bullfinch. Its voice embraces the notes and semi-notes between the low contralto and high tenor. It can also imitate the wild bird's notes and whistles every month in the year.

The avadavat, comes to us in great numbers from China, Asia, Africa and India. Unlike other birds, it changes its plumage yearly until the third year. At this time, the head and under part of the body are a fiery red tinged with black, the back brown, tail black, wings a reddish brown; all the feathers are tipped with white, giving the bird an appearance of being specked with white spots.

The Gray-blue finch has a song that seems to be a mixture of the canary's and bobolink's, but much finer than either. It adheres to the southern tropical spring month for its breeding and rearing season. In November, it begins to build in the aviary and rears its young in midwinter.

The Silver-bill or *Quaker bird*, the *Orange-cheek waxbill*, the *Zebra* or *Orange-breast waxbill*, the *Chestnut finch*, and the *Magpie finch* are all aviary birds, and are much sought for their song and peculiar mannerisms, their diminutive size and brilliant colors.

Nuns. — No aviary is complete without the nuns, both black- and white-capped, their white heads forming a rich contrast to the chocolate-brown and black bodies. Japanese nuns are a combination of the purest white intermingled with the much admired cinnamon color. These pets, being bred in cages, are very tame and of a quiet disposition, and sing very merrily.

The Cordon Blue, a native of Africa, is a small bird of great beauty. Sometimes he is called the Crimson-ear waxbill. The male has a soft, pleasing song and is usually heard cooing as if for his own pleasure.

The Cut throat sparrow, a native of Africa, is about half the size of a canary, of a delicate grayish fawn color spangled with white spots.

The St. Helena waxbill comes from Africa in great numbers. The beak is a bright red, resembling sealing-wax, with a darker shade of the same color passing through each eye, and a dash of the same color under the body, the rest of the body being a grayish brown. The wings and tail are a shade darker. All the feathers have blackish wavy lines all over them, giving them a soft and silken appearance.

The Diamond sparrow is a native of Australia and is a short, stout bird somewhat larger than the St. Helena waxbill. The under part of the body is white, and the sides under the wings black with oblong white spots.

The Fire finch is very much like the avadavat at certain seasons of the year. It is larger but does not possess much song, being kept chiefly for its beauty and cheerful disposition.

The Saffron finch is very similar to the canary, although not so large.

Parrots.

The parrot is the best known among the talking birds. Many individuals have acquired several languages and whistle and sing any song that they hear.


Fig. 523. Gray parrot.

The African Gray parrot (Fig. 523), with gray body, black bill and scarlet tail, takes high rank. It varies from twelve to fifteen inches in length. It is an excellent talker and whistler, but individuals vary greatly in their ability to learn.

The Double Yellow-headed Mexican parrot is the operatic star of the parrot family. His gift of song is great, and his voice is clear and sweet. He is a beautiful green throughout the body, with pale orange forehead and scarlet and blue feathers, his feet and beak white.

The Carthagena parrot is thirteen to fifteen inches long and has all green plumage, except on the back of the neck, where there is a pale orange marking about the size of a half-dollar, and in the wing and tail feathers where red and blue markings occur. This bird becomes a good singer and whistles and talks very well.

The Single Yellow-headed parrot is smaller than the double yellow-headed, but has the same colors, except that the beak is dark instead of flesh color. It makes a fair talker.

The Amazon is a native of upper South America. It is not so large as the Mexican but is an apt pupil and easily learns to talk and sing.

The Blue Front is twelve or thirteen inches long, with plain green body and blue forehead, and slight red and blue markings on the wings. It also becomes a fair talker.

The Maracaibo parrot is like a small edition of the Mexican. It is about ten or eleven inches long and sometimes makes an excellent talker.

Plate XVIII. A poultry establishment in New York; and a flock of turkeys

The Cuban parrot is ten to twelve inches long, with green body and white forehead, scarlet throat and scarlet and blue wings. It is usually imported when about three months old and is tame and very teachable.

Paroquets.—The name paroquet is applied to the smaller kinds of parrots. The Australian paroquet is a beautiful and eccentric bird. It easily becomes domesticated to cage life, and can be taught many amusing tricks.

The Dwarf parrot is a little fellow found often in our town bird stores, although not common enough to be generally known. It is a little larger than the paroquets or love birds, and of a uniform green on the body, with a bit of orange or red about the bill or throat and wings. It is said to do some talking occasionally.

Literature.

Dogs.—J. V. Mott, Boston Terrier; R. B. Playeman, House Dogs, Care and Treatment; Eugene Glass, Cocker Spaniel; H. Daziel, Diseases of Dogs; Ashmont, Dog Management and Treatment; Al. G. Eberhardt, Everything About Dogs; Ashmont, Kennel Diseases; Ashmont, Kennel Secrets; J. W. Hill, Management and Diseases of Dogs; S. T. Hammond, Practical Dog Training; W. C. Percy, Principles of Dog Training; E. H. Haberlin, Amateur Trainer; Stonehenge and Armatage, The Dog; W. A. Sargent, Collies Useful and How to Make So; J. Watson, The Dog Book; H. C. Tugg, American Foxhound; W. Mills, The Dog in Health and Disease; B. Waters, Training Hunting Dogs; B. Waters, Modern Kennel Management.

Rabbits and cavies.—Ambrose, Belgian Hare Rabbits and All About Them; Moss and Ambrose, The Dutch Rabbit; Knightbridge, The Lop Rabbit; L. Shaw, The English Rabbit; Richardson, The Rabbit; K. W. Knight, The Book of the Rabbit; E. Ruth, Belgian Hare Culture; E. Ruth, The Belgian Hare; Cunniculus, The Practical Rabbit Keeper; P. O'Brien, The Belgian Hare; Rayson, Rabbits for Prizes and Profit; T. B. Mason, Something About the Silver Rabbits; C. A. House, The Cavy; John Robins, The Cavy; C. L. Merick, All About Cavies; Ellard and Johnson, Flemish and Angora Rabbits, in preparation.

Mice.—Beake and William, Fancy Mice; "An Old Fancier," Fancy Mice.

Pigeons and cage-birds.—Browne and Walker, American Bird Fancier; C. A. House, British Canary; G. H. Holden, Canaries and Cage Birds; G. H. Holden, Book on Birds; C. N. Page, Canary Breeding; R. L. Wallace, Canary Book; J. D. Bradman, British Birds; C. N. Page, Feathered Pets; W. F. Greene, Our Feathered Pets; Fulton and Wright, Book of Pigeons; Feather's Practical Pigeon Book; Pigeon Standard; Pigeon Queries; F. M. Gilbert, Pigeon Keeping; Twombly, Squab Culture; L. Hoser, Homing Pigeon, Breeding and Training; J. A. Summer, Diseases of Pigeons; R. Woods, Dragoon Pigeon; C. A. House, Fantail Pigeon; C. H. Jones, Homing Pigeon of the Twentieth Century; E. C. Rice, Squab Book; W. F. Lundey, Owl Pigeon; W. F. Lundey, Turbit Pigeon; F. M. Gilbert, Pigeons; L. Wright, Practical Pigeon Keeper; J. C. Long, Practical Pigeon Book; W. E. Rice, Practical Squab Book; A. V. Meerch, Pigeons; J. E. Webber, Working Homers; Vale, How to Feed Pigeons; R. Woods, Diseases of Pigeons; R. Woods, Successful Pigeon Culture; Blaxton and Others, Book of the Canary; Beckstein, Cage Birds.

POULTRY. Figs. 524–604.

One of the features of the new contemporaneous agriculture is the attention that is given to the poultry live-stock. In former time, the fowls were an unaccounted incident of the farm. They lived on the refuse and on such food as they might find in a free range, and all they produced in the way of meat, eggs and feathers was counted as clear gain. Because they thrived anywhere, cost practically nothing to keep, multiplied rapidly, and the individual birds were not valuable enough to occasion much loss if one or several died, giving at the same time a steady and marketable product, fowls became associated with practically every farm. Fowls are kept on more farms and separate homesteads than any other domestic animal except cats. Just because fowls will take care of themselves, they have been neglected; and not until recent census and revenue figures were available did we know the immense economic returns that poultry live-stock gives to the people.

With the gradual refining of agriculture and the application of business methods to it, we have begun to realize that it is possible greatly to extend the usefulness of all kinds of fowls. The birds are coming to occupy a distinct department of a good farm enterprise, as are sheep or orchards or pigs, and the old phrase "barnyard fowls" is dropping from use. There are two types of poultry husbandry,—that which considers the birds as a part of a general farm business; and that which makes a specialty of fowls, with all other products subordinate to them. In the latter class are establishments making a business of producing eggs and meat, and other establishments making a specialty of breeding.

We have now learned that any real satisfaction in the rearing of poultry must come as a result of as careful study and attention as that given to any other kind of live-stock. The questions of breeding, feeding, diseases, and general management are complex and are much in need of scientific investigation. Heretofore, the special interest in poultry, so far as writers and investigators are concerned, has been descriptive,—the characterizing of breeds and the discussion of formal and fancy points. The result has been that the subjects of breeds and exhibiting have been much over-emphasized as compared with questions of performance and utility, as they have been in all other groups of animals. The entering of the colleges and experiment stations into the discussion of poultry questions is changing all this. A new and vital type of poultry literature is arising. This literature is yet largely fugitive, however, although some of it is contained in experiment station pub-

lications. We are betwixt the old and the new,—the new being the writing founded on rational scientific procedure.

The reputation of the poultry business, as a separate enterprise, has no doubt suffered from the exploitation of it by many persons who have gone into it thinking it an easy and rapid road to fortune and a means of recouping broken health. Many of these persons have failed, as they should have had every reason to expect. To go into poultry-growing as a business is a serious undertaking, as it is to go into market-gardening or dairying. The person must learn the business. There are plenty of persons who succeed well in the poultry business, and this class will increase steadily.

As a rough statement, it may be said that it costs one dollar a year per fowl to keep a flock of poultry. This cost may be reduced on a farm where the birds have free range and the feed is produced on the place; it may be increased when the birds are confined and all the feed is purchased.

What the proceeds are to be will depend on very many conditions, and for what purpose the animals are kept. The succeeding articles will throw some light on this question. A person should expect a minimum net profit from fowls reared for eggs and meat, of one dollar a year; and this profit may sometimes be doubled. [See Vol. I, pp. 183–187.]

The great effort, so far as the modification of the bird is concerned, is to increase the egg-laying capacity of the fowl. It must be remembered that the hen originally laid eggs for the purpose of perpetuating her kind, as the cow gave milk merely to sustain her calf for a time. Instead of producing one or two broods of eggs, good hens will now lay as many as 200 eggs a year, and the record for individual birds exceeds this. This result is brought about by long-continued attention to breeding, by rational feeding, by good care, and by the stimulus of comfortable and healthful quarters. The egg-laying ability is also conditioned on the age of the bird. Pullets usually lay best. Poultrymen therefore like to keep only young fowls, disposing of them for meat about the end of the first year. By controlling the period of hatching, much may be done to induce egg-laying in the cold months, when the fowl would not naturally lay. The pullets should be fully mature and in laying habit before cold weather sets in. Thereafter the problem is one of feed, exercise and housing. Probably half the fowls in the country are not laying in the winter months, and for this reason eggs are high-priced in this period. It is easier said than done, to be sure, to produce freely of winter eggs; but the result is obtainable, as we shall find when we learn how to prepare for the crop of eggs as we prepare for a crop of potatoes or beans.

Illustrations of egg-laying under practical conditions have been given us as follows: *New Jersey.*—274 pullets, about two-thirds of them White Wyandotte and the remainder Barred Plymouth Rock, laid 815 eggs in October, 1,247 in November, 2,024 in December, 2,956 in January, 3,326 in February, 4,933 in March, or a total for the six months of 15,301. *Massachusetts.*—172 pullets, 45 yearlings, all White Wyandotte, laid 1,390 eggs in November, 1,787 in December, 2,537 in January, 2,940 in February, 4,035 in March, a total in five months of 12,689. *Maine.*—The wife of a dairyman keeps about four hundred and fifty head of Barred Plymouth Rocks, and her accounts for the past five or six years show an average of better than two dollars a year net profit per fowl from the eggs sold to market and the fowls sold alive before the time of the molt. The average egg-product is ten to twelve dozen eggs per bird, and the average prices have ranged, for the series of years, somewhat over twenty-five cents per dozen, which gives a return of over two dollars and fifty cents for each bird per year. The hens sold alive to market average a return of about a dollar apiece.

As there are beef types and milch types of cattle, so there are meat types and egg-laying types of fowls; and there are many fancy kinds, as the game cocks, frizzles, and abnormal forms. No domestic animals of the live-stock kind possess so many curious and interesting forms, particularly if we include in the poultry class all the pheasants, guinea-fowls, peafowls and swans. In the farm-poultry of the past, no particular distinction was made between meat fowls and egg-laying fowls, as there was no distinction between beef cattle and milch cattle; therefore, there was no special selection or breeding along the divergent lines by the general farmer. There is a general-purpose or dual-purpose fowl as there is a dual-purpose cow, and this type of fowl, much improved, will probably hold preëminence under general farm conditions.

Considered in its economic results, the greatest utility of poultry husbandry no doubt is its part in general farming, inasmuch as it is adapted to practically every kind of farm scheme. And it is in this field also that the greatest study and effort need to be expended. The poultry specialist is an enthusiast and he keeps in touch with every new thing pertaining to the business; but the general farmer has other and perhaps larger interests, notwithstanding the fact that no part of his business will probably yield a greater return for extra care and attention than the poultry part.

Poultry-raising must come to be a regular part of the plans for agricultural education. This will place the subject in its proper relation with other farm business. The colleges of agriculture are now beginning to realize this fact and to act on it. In the secondary schools, fowls probably afford the most attractive and adaptable means of teaching many of the fundamental principles of the live-stock industries. Education has now reached the point at which it is ready and willing to utilize the common affairs as means of training men and women; and there are departments in the colleges devoted wholly to poultry, and professorships in the subject are beginning to be created.

When we gather the poultry statistics from all the farms and homesteads of the country, we find that the figures assume enormous proportions. The latest available statistics are those of the Twelfth Census, 1900, some of the summary items of which are as follows:

POULTRY AND EGGS.

	Number of farms	Number of farms reporting	Number of fowls three months old and over, June 1, 1900			
			Chickens (and guinea-fowls)	Turkeys	Geese	Ducks
United States	5,739,657	5,096,252	233,598,085	6,599,367	5,676,863	4,807,358
North Atlantic Division	677,506	605,732	27,952,114	529,932	144,527	453,580
South Atlantic Division	962,225	850,074	22,293,912	810,975	908,908	458,918
North Central Division	2,196,567	2,014,138	123,469,068	3,072,456	1,899,026	2,416,327
South Central Division	1,658,166	1,441,315	50,299,631	1,876,382	2,589,164	1,257,048
Western Division	242,908	184,021	9,551,296	304,950	135,163	199,977

	Value of all poultry, June 1, 1900	Value of poultry raised in 1899	Dozens of eggs produced in 1899	Value of eggs produced in 1899
United States	$85,794,996	$136,891,877	1,293,819,186	144,286,158
North Atlantic Division	15,706,762	20,624,439	191,764,000	28,612,489
South Atlantic Division	8,545,899	15,553,805	105,349,996	11,687,293
North Central Division	43,[illegible]6,629	69,828,121	716,663,710	74,208,117
South Central Division	15,672,938	24,770,049	222,096,860	20,465,926
Western Division	4,414,365	6,053,738	57,787,867	9,266,716

More recent poultry figures, from the Department of Agriculture Yearbook, may be cited as follows :

EXPORTS.

For the year ended June 30, 1902.

	Quantity	Value
Eggs, dozens	2,717,990	$528,679
Egg yolks	....	14,700
Feathers	....	239,756
Poultry and game	....	856,801

For the year ended June 30, 1906.

	Quantity	Value
Eggs, dozens	4,952,063	$1,038,649
Egg yolks	....	54,851
Feathers	....	263,377
Poultry and game	....	1,397,004

WHOLESALE PRICE OF AVERAGE BEST FRESH EGGS PER DOZEN.

	January, 1901		January, 1906	
	Low	High	Low	High
New York	19½ cts.	27 cts.	17½ cts.	34 cts.
St. Louis	15½ cts	18½ cts.	14 cts.	22 cts.

	June, 1901		June, 1906	
	Low	High	Low	High
New York	13 cts.	14½ cts.	17½ cts	23 cts.
St. Louis	8½ cts.	10 cts.	15 cts.	17½ cts.

The summary figures of the number of fowls in Canada in 1901 are as follows :

British Columbia, 363,379 ; Manitoba, 1,167,-876 ; New Brunswick, 714,131 ; Nova Scotia, 798,145 ; Ontario, 10,464,551 ; Prince Edward Island, 581,790 ; Quebec, 3,283,643 ; the Territories, 549,143.

Number of poultry killed or sold (1901), 7,063,-597, all Canada ; number of eggs (1901), 84,132,-802 dozens, all Canada ; value of poultry (1901), $5,723,890, all Canada.

If the reader is interested in statistics of education in poultry husbandry in Canada and the United States, he should consult pages 55 to 88 of the Proceedings of the 32d Annual Convention of the American Poultry Association, 1907.

Literature.

Following are some of the reference books on poultry subjects. Much helpful information will also be found in experiment station publications, and those of the national Department of Agriculture. American Standard of Perfection, published by the American Poultry Association; Wright, Book of Poultry, Cassel & Co., London ; Salmon, Diseases of Poultry, Geo. E. Howard & Co., Washington, D. C.; Stoddard, New Egg Farm, Orange Judd Company, New York ; Lewis, People's Practical Poultry Book, Excelsior Publishing House, New York ; Norys, Pocket Money Poultry, Geo. E. Howard & Co., Washington, D. C.; Tegetmeier, Poultry Book, Routledge & Sons, London ; Felch, Poultry Culture, Donohue, Henneberry & Co., Chicago ; Wright, Practical Poultry Keeper, Orange Judd Company, New York ; Watson, Farm Poultry, The Macmillan Company, New York ; Robinson, Poultry Craft, Farm Poultry Publishing Company, Boston ; Collingwood, The Business Hen, Rural New-Yorker ; Biggle Poultry Book, The Farm Journal Company, Philadelphia ; Weir, The Poultry Book, with colored plates, by Doubleday, Page & Co., New York ; Perfected Fowls of America, Howard Publishing Company, Washington ; Barrows, Eggs ; Robinson, First Lessons in Poultry Keeping ; E. C. Powell, Making Poultry Pay ; McGrew, Perfected Poultry of America ; Davenport, Principles of Breeding ; Poultry Houses and Fixtures, Reliable Poultry Journal ; Reliable Poultry Remedies, Reliable Poultry Journal ; Robinson, Broilers and Roosters ; Ducks and Geese, Reliable Poultry Journal ; Hewes, Hamburg Book ; The Leghorns, Reliable Poultry Journal ; Report of Second National Poultry Conference, Reading, England.

INDEX TO POULTRY ARTICLES

Origin of the Domestic Fowl. *Gallus* spp. *Gallinæ*. Fig. 524.

By *Charles B. Davenport*.

The domestic fowl belongs to the group of scratching birds that includes also the turkey, guinea-fowl, pheasant, partridge, grouse. The ancestors of the domestic fowl, like those of other domestic animals, were wild species, but it does not follow that there was only one ancestral species or that all the ancestral species, if more than one, still persist. Without going into the history of ideas concerning the ancestry of fowl, it may be said that probably two species were involved—one a wild form still common in the jungle of India, southern China and the East Indies, and known as *Gallus ferrugineus*, or as *Gallus bankiva* (Fig. 597); the other, probably an extinct progenitor of the Aseel or Malay fowl (Fig. 524). The *Gallus ferrugineus* is a slender-bodied bird, having its plumage colored like that of the Black-breasted Red Game fowl, and having a single comb, slender, willow - colored shanks and capable of considerable flight. It is completely fertile with domesticated fowl.

Fig. 524. Aseel fowl.

The other extant wild species of Gallus are much less like any of our domestic races and are usually sterile with them. The reason for concluding that a second species had been involved in the construction of our domestic races is the existence among them of a set of characters, other than the usual color sports, that cannot be derived from the jungle-fowl. Some of these are a broad, stocky body, a triple or pea-comb, stout, yellow-skinned legs, a mottled plumage and an unwillingness to fly far in the air. Such characters are found, for example, in the Brahma fowl. They are also found in the Aseel, probably the oldest fowl in domestication. The Aseel has been bred in India for over 3,000 years, and its wild ancestors seem to have become extinct. Starting with the jungle-fowl and the Aseel, we can write an intelligible history of the domestic fowl, but we could hardly do it if we started with the jungle-fowl alone.

Progress of domestication.

The history of the domestication of the fowl reaches, as suggested above, to a remote antiquity. The Institutes of Menu, 1000 B. C., alludes to the sport of cock-fighting (probably with the Aseel). From southeastern India the domesticated fowl spread eastward and northward, reaching China, according to tradition, about 1400 B. C., and subsequently gaining Japan. The movement toward the West took place later. It is figured on Babylonian cylinders of about 600 B. C., and Aristophanes (about 400 B. C.) refers to the fowl as the Persian bird. As it is not mentioned in the Old Testament, the fowl probably did not reach Syria until three or four centuries before the beginning of our era. Its introduction into Europe from Persia was probably effected at the time of the conquest of that country by Alexander (330–320 B. C.). Once in Europe, the spread was rapid over that continent. Caesar found fowl in Britain, whither they had probably been carried by the Phœnicians, at the time of his conquest of that country about 55 B. C. It is probable that, at a later date, fowl were introduced into Europe from Central Asia through Siberia to Russia. From Europe, fowl were carried in the early period of colonization to the New World and parts of the Old World, where, up to that time, they had been unknown.

The character of the fowl first bred in China and eastern India differed from that of the western birds, for the eastern fowl were of the stocky Aseel type. Foot feathering, the uniform buff-colored plumage and the reduction to bantam size were early achieved by the Chinese. The Buff Cochins, the source of all uniformly buff fowls the world over, were cultivated in Hoangho 1,500 years ago. The western fowl were more of the jungle-fowl type: slender, active, clean-shanked birds. These came to inhabit the whole Mediterranean coast from Egypt, through Syria, Asia Minor, Greece, Italy and France, to Spain and the islands lying off shore. Thence arose our Mediterranean fowl — active birds, largely non-sitting; such are the Leghorn, Minorca, Spanish, Andalusian, Hamburg, Ancona, Polish, Houdan, and many other varieties. The colors became varied through the preservation of various sports that cropped out: a melanic sport, as seen in the black Minorcas and Spanish; a "gray"-white sport, as seen in the white Leghorn; and mottled or blue forms, derived by crossing the black and white, as seen in the Hamburg, Ancona, and Polish. Certain teratological conditions were preserved: a fifth toe, known even to the Romans,

and preserved till today as the trademark of the Dorking and Houdan races; a cerebral hernia, known for over four hundred years, and become a trademark of the Polish and Houdan; and a rudimentary comb, probably associated originally with the cerebral hernia but now capable of being inherited independently of it.

The fowls first imported to America were Games (largely in the South), Leghorns direct from Italy, and certain English derivatives of the Mediterranean breeds, such as the Dorkings and Scotch Grays, with their barred markings from which the barred Plymouth Rocks of today have probably been derived, in part. On this stock were engrafted, by importations, the stocky eastern types · the Brahmas, from the Brahmapootra river and the Cochins from Shanghai, China. The latter two were used to give the breadth and weight of our Plymouth Rocks, Wyandottes and others; the pea-comb of the Brahma has been used to reduce the great single comb of the Mediterranean breeds to form the neat comb of the "Rocks," and the solid buff color has been used in the Rhode Island Reds as well as the buff varieties of the Plymouth Rocks and Wyandottes. The effect of crossing the Mediterranean and Asiatic types has been to give a general-purpose fowl of great utility to the farmer, who needs a hen that is a fair layer, a good mother, and a meat-producer. The American experiment of making a general-purpose fowl proved so successful that it was repeated in England and resulted in the Orpingtons, made up of various combinations of Mediterranean, Eastern and American types. Thus, the general-purpose fowls of both England and America owe their origin to combinations of the derivatives of the jungle-fowl and the Aseel types. But, for egg-production, the Mediterranean type has never been surpassed, and as a table bird the Aseel derivatives, including the Indian Games, Cochins and Brahmas, have no rivals.

Literature.

For references, see page 527.

Breeding of Poultry. Figs. 525–530.

By *Charles B. Davenport.*

Perhaps one of the best tests of the domestication of an animal is the control by man of its reproduction. Broadly, this control includes the feeding and housing and all the apparatus for restricting the free intercourse of the sexes. Leaving these technical details for description elsewhere, this article will consider only the principles to be followed in selecting fowls for the breeding-pen in order to achieve a certain ideal; and some account of the results attained by breeders who have followed these principles, often more or less unconsciously, may be added.

The ideal and methods of attaining it.

The first requisite in breeding is a clear-cut ideal. Let the breeder formulate clearly in his mind what he wants to get, for the end will determine the details of the procedure. The ideal may be simple, such as increased egg-yield, or more rapid growth, or greater vigor of stock, or a reduced size of comb; or it may be complex, as, for example, increased yield of eggs of a brown color, or large size combined with heavy egg-yield, or a large white bird with a small comb and laying many brown eggs of a large size. In case of such complex ideals, it is a good rule to work for one or two things at a time. In any case, the ideal should be resolved, as in the foregoing examples, into the maximum number of well-defined characteristics that are to be combined in the ideal bird, and then the proper means taken to get the combination.

Inbreeding and line-breeding.— In beginning to work for the ideal, it is highly desirable to start several families at once, because, if only one pair be mated, the progeny must be mated with each other, or with the parents; i. e., close inbreeding must be practiced, and this is very likely to be disastrous. It is the general experience of breeders that very close inbreeding tends to produce chicks that are weak and fall an easy prey to disease, or which, if they survive, are infertile. By starting two or more unrelated pairs, it will be possible in later generations to introduce new blood without retarding, as much as would otherwise be the case, the progress toward the ideal. In some cases it is impracticable to start several families. In such cases, it is considered better to mate the offspring of a pair with father and with mother respectively, than to mate brother and sister. The "grandchildren" of the original father may now be mated to those of the original mother, and also back on their parent-grandparents. By carefully mating in each generation the most distantly related individuals, matings of full brother and sister are avoided. This method of breeding is called line-breeding. It is illustrated in the accompanying chart prepared by I. K. Felch. (Fig. 525.)

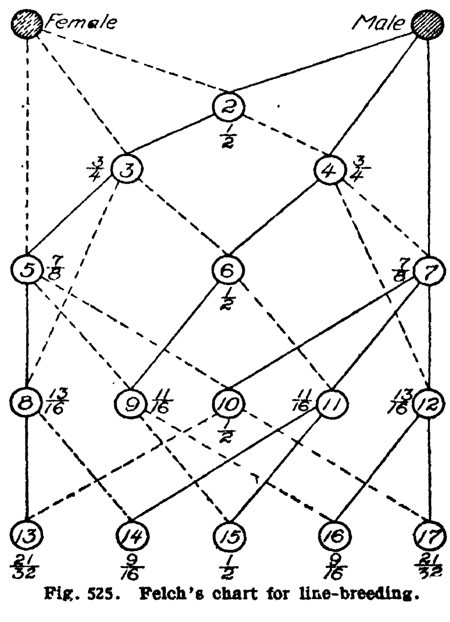


Fig. 525. Felch's chart for line-breeding.

In the chart, a dotted line represents female blood (egg), and a full line male blood (sperm); the circle at the union of two such lines indicates the progeny of the union of the egg and the sperm. In the third filial generation, whose blood is derived equally from the two parents, No. 10 constitutes a strain distinct from No. 8, which has thirteen-sixteenths blood of the original hen, and from No. 12, which has the same proportion of the original cock. From these three strains, by proper manipulation additional strains may become established.

The methods employed for attaining an ideal are of two general sorts, depending on the end sought. If it is desired merely to improve a quality already present, the method of selection is employed. If, on the other hand, it is desired to add a new characteristic to a given breed or to combine the characteristics of one or more breeds, then hybridization is necessary.

Selection involves the careful inspection of the individuals of any generation, and the preservation for breeding of only the best. Let it be required to improve the egg-yield of a given strain : study the egg records of the yearling hens, and preserve for breeding the progeny of the best. Let it be required to increase the rate of growth : keep and study growth records, and save the fastest growers for breeders. Even those who do not keep records make a selection, as the breeding season approaches, of the most vigorous cocks and the shapeliest hens, and this rough selection helps to maintain the strain at a high standard of general excellence. A more rigorous selection and selection for particular points often involves measurements, weighing, and the like, and pedigree breeding, of the methods of which something will be said in a later paragraph.

Hybridization involves the crossing of two strains, varieties, or races in order to combine the favorable qualities of the two. Eventually, the qualities of three or more races may be combined. Let us suppose a breeder finds that, in his excellent strain of Minorcas, the large combs are likely to get frostbitten, so that the reproductive processes are interrupted ; and he has the idea of replacing the large single comb with the small pea-comb. He must first cross his Minorcas with a Dark Brahma or Indian Game, or some other race that has a pea-comb. He will find that, even in the first generation, all of the "hybrids," as they are called, have the pea-comb. But his goal is not reached in the first generation, because the hybrids have certain characteristics of form, feathering, and the like, that he does not want, and because in the second generation a single comb will crop out again. The second generation of hybrids (got by breeding members of the first generation) is technically known as the second filial generation, or F_2. It will yield a great variety of combinations of form, feathering, fecundity, and so on, combined with a pea-comb. The breeder selects for breeding the combination that comes nearest to his ideals. But it will still be several generations before his ideal is fully realized. In this connection, a knowledge of Mendel's law will be helpful.

Mendel's law states that, when, in two races that are being crossed, there is a pair of contrasted characters, as single comb and pea-comb, only one of the pair will appear in the progeny ; it will *dominate* over the opposite ; and as the other has receded from view, it was named by Mendel the *recessive* character. Dominance of a character in the body does not imply that the recessive character is absent, but only that in the development of the body the dominant character is bound to appear. The dominant character is usually a stage in advance of the recessive, so that one may say an organ will develop to the highest stage that is potential within it. So a pigmented condition dominates over absence of pigment, extra toe over the normal number, feathers on the feet over their absence, and the lateral ridges of the pea-comb over their absence in the single comb.

But while in the body of the first generation the dominant character is uniformly visible, the germ cells (eggs and sperm) in their repeated division become of two kinds, those possessing the recessive character only and those possessing the dominant character only ; and these are equally numerous. Consequently, in the haphazard union of any egg and any sperm, these four combinations are equally likely to occur, forming the second generation (F_2): Two germ cells with the recessive character (the union may be expressed as RR); two with the dominant character (DD); and a dominant egg with a recessive sperm (DR), and a recessive egg with a dominant sperm (RD). The individuals that develop from the first kind of union, having none of the dominant character, are of the recessive type only and form germ cells of this type only. They are technically called *homozygous*. Conseqently, two individuals of the recessive type bred together will have progeny of that type only and may be ancestors of a race pure in respect to the given character. The individuals that develop from the second kind of union (DD), having none of the recessive character, will not only be of the dominant type but may found a race pure in respect to the dominant character. The other sorts of individuals (DR and RD) are hybrids like their parents, and are called technically *heterozygotes*. Bred together, heterozygotes will produce homozygous recessives and dominants and heterozygotes again. There will be two of this type to every one of the pure dominants. Thus, heterozygotes are essentially impure. While the first hybrid generation is characterized by uniformity, the second generation is characterized by great

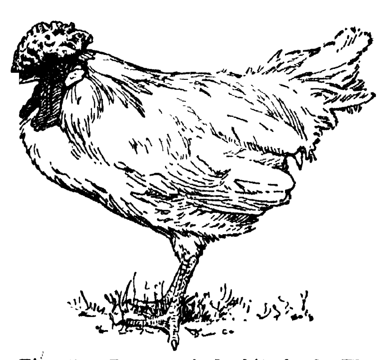


Fig. 526. Rose-combed white fowl. The grandchild (F_2) of a rose-combed Black Minorca and a single-combed White Leghorn. See Fig. 527.

variety. In Figs. 526 and 527 are shown two grandchildren (F_2) of a rose-combed Black Minorca and a single-combed White Leghorn. Among others, a rose-combed white and a single-combed black fowl appeared, thus reversing the relation of comb and color.

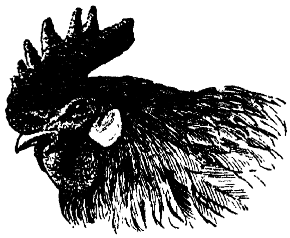


Fig. 527. Single-combed black fowl. The grandchild (F_2) of a rose-combed Black Minorca and a single-combed White Leghorn. See Fig. 526.

Since the heterozygotes contain the dominant character, this alone will appear in the body as in F_1, and it will often be impossible to distinguish between a homozygous dominant and a heterozygote. Yet, to get a pure race one must separate them. Consequently, the dominants of F_2 must be tested. To test a dominant, mate it with a recessive. If the dominant is pure (DD), all offspring will be of the dominant type ; if impure (DR), the offspring will be equally of the combination DR and RR, and hence half of them will be of the recessive type. Hybrids, which, on testing, throw only dominants, may be used to found a pure dominant race. Thus, one character at a time (or several at a time if great numbers be available), a race pure in respect to the desired characters, whether dominant or recessive, may be built up. And the progeny of members of this race, bred *inter se*, will ordinarily show no reversion to the eliminated characters. The new race is established but it is not yet perfected.

Fig. 528. A Game-colored Frizzled fowl. See Fig. 530.

In the process of hybridization, the various characters often become somewhat damaged. It will be necessary to improve them ; and this is done by the process of selection. Those individuals in which one or more of the characters approach most nearly to the ideal are preserved for breeding. Thus, in a few generations the ideal may be fully achieved.

It may be of assistance to give here a table of some of the characters of poultry, showing which are dominant and which recessive. It sometimes happens that certain advanced conditions are incompletely dominant over the less advanced or rudimentary characters. Characters usually showing incomplete dominance are marked by a †.

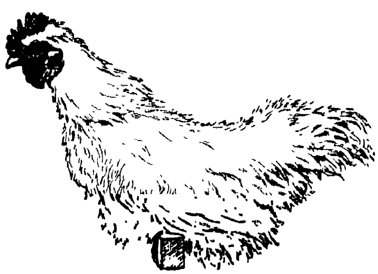


Fig. 529. An albinic Silkie fowl. See Fig. 530.

Characters	Dominant condition	Recessive condition
Comb	Lateral elements (in pea and rose)	No lateral elements
Cerebral closure .	Perfect, plain skull	Imperfect, hernia as in Houdan or Polish
Crest	Present	Absent
Feather, form . .	Typical, plain	Embryonic, silky
Feather, form . .	Frizzled	Plain
Muff	Present	Absent
Skin color . . .	Pigmented, black	Unpigmented
Iris color	Heavily pigmented, black	Red
Plumage color .	Pigmented	Albinic, white of silkies, etc.
Plumage color .	Gray-white of White Leghorn	Pigmented
Shafting	Present	Absent
Penciling	Present	Absent
Extra toes . . .	†Present	Absent
Booting	†Present	Absent
Egg pigment . .	Present, brown	Absent, white
Broodiness . . .	Sitting	Non-sitting

Combinations of characters.

Ordinarily, the hybrid shows no new character but only a new combination of the parental characters. Occasionally, however, an apparent exception makes its appearance. Thus, when a white and a black bird are mated, it sometimes happens that the hybrids have a blue plumage. This blue is really a fine mosaic of black and white and is best known in the race of poultry called Andalusian. When two blue birds are mated, however, they throw black and also white chicks as well as blue ones. The blacks and the whites are homozygous and the blues heterozygous again. Similarly, under certain circumstances the crossing of a light and a dark bird may produce offspring with a barred plumage ; and two such barred birds will throw light birds and dark birds again as well as barred birds. Again, if a single-combed fowl is crossed with one having two horns, as the Polish, the hybrid has a Y-shaped comb ; but in F_2, the single and the paired combs reappear. In all these cases we have a heterozygous form due to the mosaic-like union of the two contrasted characters. The mosaic is not a permanent character but only the badge of impurity. Whether a heterozygous form can ever be fixed is a moot question. The barred condition

Fig. 530. The granddaughter, by inbreeding, of the Frizzled (Fig. 528) and the Silkie (Fig. 529) fowls. Showing how characters may be combined in the second hybrid generation.

has apparently been fixed in the Plymouth Rock and a mottled condition in the spangled races, and it is even alleged by certain fanciers that they have fixed the Andalusian blue. The history of fixation, however, in any case, is still obscure.

In order to show how characters may be combined in the second hybrid generation, Figs. 528–530 are introduced. Fig. 530 shows the granddaughter (by inbreeding) of the Frizzle and the Silkie. [Figs. 528, 529, are adapted from Publication No. 52, Carnegie Institution of Washington.]

Reciprocal crosses.

The crossing of distinct varieties introduces certain special questions in addition to the general one of the behavior of alternative characters. The commonest is that of the behavior of reciprocal crosses. When two races are crossed, are the offspring the same whichever race is used as the male parent? In general, it may be said the product of a given cross is the same as that of its reciprocal. This is true, however, only within limits. If one race is a bantam and the other large, the size of the egg and consequently of the chick will be determined by the mother, so that if the mother is the bantam the chicks will be bantams, but if she is of full size so will they be. There are occasionally other differences in reciprocal crosses. The present writer has found that the "booting" of the progeny is likely to be heavier when it is the mother that is booted than when it is the father. Other slight differences of this sort no doubt occur at times.

Double mating.

Quite different is the operation of double mating. Several races of poultry show sexual dimorphism, and breeders have sought to exaggerate the difference between the sexes. If it is desired in the dark Brahma to perfect the penciling of the female but to group the colors of the male into masses, then one selects, to improve the hens, the best penciled hens to mate with a cock showing as much lacing as possible; and to improve the cocks, the darkest hens to go with a cock that is devoid of lacing and other small feather patterns. Thus, the sexual dimorphism in color pattern may be increased.

Control of sex.

Still another problem is that of the control of sex in the offspring. Since one cock will suffice for many hens, an excess of female offspring, especially on egg-farms, is desired. Despite the fact that directions for securing a predominance of either sex are frequently published in poultry books, there is every reason for thinking that a great deviation from the average proportion of 50 per cent of each sex is found only as a rare accident. It seems probable that sex is determined at the moment of fertilization of the egg and by a particular combination of particular kinds of germ cells. Sex control in birds, as in mammals, seems at present beyond our human power, notwithstanding certain opinions to the contrary.

Breeding superstitions.

Two alleged phenomena of breeding must be relegated to the limbo of superstition. One is that of the influence of a former sire on the character of subsequent chicks. Even after a cock has been removed from a pen he may be the father of offspring in that pen because the sperm of the male is retained in an active condition by the hens for ten days or more. But if, after the eggs have completely ceased to be fertile, a new cock is added, different from the first, no influence of the first cross will be detected. Stories to the contrary doubtless depend on unsuspected impurity of the second cock. So, too, there is no ground for believing in the "influence of the imagination" in modifying the character of the offspring. One hears such stories as these: A flock of Brown Leghorns in a pen adjacent to White Indian Games began to produce white progeny; or a breeder of White Cochins kept them next to a pen of Black Minorcas and the former produced chicks that were black splashed. In both cases it is more than likely that a cock from the adjacent pen climbed over the fence and fertilized the eggs.

Reversion.

One of the most striking instances of an apparently new character appearing in hybridization is seen in the examples described by Darwin as cases of reversion. Darwin taught that hybridization *per se* leads to a reversion on the part of the offspring to the ancestral characters of the jungle-fowl. An analysis of the facts in poultry does not support Darwin's views of reversion. Black birds and buff birds may be crossed with White Leghorns without the appearance of the jungle type of coloration. When, however, a White Silkie (whose plumage is truly albinic) is crossed with a black bird, as Minorca or Spanish, the black sons have red on the back, hackle, saddle and wing bars, as in the jungle-fowl. Whence has the red come? Darwin ascribed it to reversion. But if a White Silkie be crossed with a White Leghorn, the males are wholly white except for red hackle, saddle, back and wing bar. Other experiments show that the red comes from the Silkie but is not visible in it, due to the absence of pigment. When pigment is added (even the hidden pigment of the White Leghorn plumage), the red appears. It is not the jungle-fowl coloration, but solely the red that results from the hybridization. The remainder of the hybrid plumage may be white or black or buff. The alleged reversion of hybrid fowls is then merely the staining, as it were, through a cross with a pigmented bird, of an otherwise invisible color pattern in albinic fowl.

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[See also page 527.]

Feeding Poultry.

By *James E. Rice.*

Domestic poultry are omnivorous. All classes of poultry, including the domestic fowls, turkeys, ducks, geese and guineas, eat freely and naturally of the grains, meat foods and green forage. They differ, however, in habits of eating as regards their preferences for certain classes of foods. For example, fowls may be classed primarily as grain-eaters, turkeys and guineas as insect-hunters, ducks and geese as grazers and fishers.

What constitutes a good ration.

The digestible nutrients.—First of all, a good ration must contain a sufficient quantity of digestible nutrients to meet the needs of the animal. This means that the ration must be varied in quantity and composition, according to the size, age, condition and environment of the animal. The amount of food which a flock of fowls requires must be determined by knowing the kinds and composition of the foods available, and the kind, size, age and productivity of the bird to be fed. With these data, rations may be compounded which will be likely to meet the requirements. With our present knowledge of the digestibility of feeds and the feeding standards for poultry, it is unsafe to depend solely on calculated rations.

The animal's appetite is a safer guide as to the amount of food which it needs than is the most carefully calculated ration weighed out and fed according to accepted standards. The fact that the food requirements of animals vary from day to day makes it impossible to calculate accurately in advance just how much of each nutrient should be fed. Feeding standards, nevertheless, are exceedingly helpful in forming a judgment of the animal's probable needs, to prevent the possible serious mistake of feeding radically wrong rations, which could not supply the needs of the system because they contained too much or too little bulk, or fiber, or ash, or protein, or carbo-hydrate material, in proportion to the other ingredients.

A perfect ration should satisfy the following requirements of the animal: Repair broken-down tissue; make new growth; produce heat; furnish energy; store up surplus fat to be used for heat or energy in case of need; meet the needs of reproduction.

The ration should be properly balanced.—There should be exactly enough, and no more, of the protein and carbohydrate nutrients to meet the needs of the bird. A ration must have the protein, carbohydrate and fat in proper proportion without an excess of any one. If the protein is lacking, the animal cannot make the white of the egg, nor grow new muscular tissue, and in the end will starve even with an abundance of carbohydrate. If there should be a deficiency of carbohydrate and a surplus of protein, the animal would be obliged to burn up protein for fuel, or use it for the formation of fat, which would be too expensive, and might also be injurious by overtaxing the kidneys in carrying off the waste nitrogen. According to our present knowledge of balanced rations for fowls, the food nutrients should be fed in about the proportion of one pound of protein to 4.6 pounds of carbohydrates for egg-production; one pound of protein to seven or eight pounds of carbohydrates for fattening; and one pound of protein to four pounds of carbohydrates for raising young chickens.

The ration should consist of food which the fowl likes.—Fowls have a decided preference for certain foods which cannot be accounted for by their composition. Rye and wheat are almost identical in composition, yet fowls will eat wheat in preference to rye. The following grains are preferred by fowls in the order in which they are named: Wheat, corn, oats, peas, barley, buckwheat and rye. The food should be palatable. The palatability of a food may be said to be the quality which determines a fowl's preference for it. Flavor and texture determine the palatability. The medicinal qualities and composition also are determining factors. The way a food tastes has much influence on the way it is digested. Digestion begins in the mouth. Foods that are not palatable do not stimulate the proper secretions for digestion. The mouth and stomach must be educated as to what is best for the system. The stomach tells the palate what it does not like.

Habit plays an important part in determining a fowl's preference for certain foods. It will refuse to eat grains at first, because they are new to it, that it later learns to like best: e. g., wheat will be refused at first by fowls that have been accustomed to eating other grains.

The ration should provide a good variety.—A good variety of food helps to increase the palatability of a ration. Fowls become tired of eating the same kind of food continuously. It is better to feed several kinds of foods, all of which an animal likes, than it is to feed any one food, no matter how good it may be. Fowls thus have a better chance to balance their own rations, and get foods that are best suited to their needs. A good variety prevents a fowl from eating exclusively of one grain which it may prefer, but which might cause over-fatness. It appears to be immaterial whether a variety of grain is fed at each feeding, or whether the same grains are fed separately and alternately during the day or on different days.

The ration should have sufficient bulk to enable the digestive secretions to act on it quickly.—When a large amount of certain concentrated ground grain is fed, the ration may be so concentrated that it becomes compacted in the crop. Because of the concentrated nature of a finely ground ration, which makes it possible for the food to pass quickly through the intestinal tract, the fowl is more easily over-fed. Thus, a certain amount of bulk in a ration is necessary. This is provided by feeding wheat bran, clover, alfalfa meal, or the like, to overcome the too concentrated nature of such foods as oil-meal, wheat middlings, corn meal, and the like. The whole or cracked grains also give bulk to a ration.

The ration should not contain too large an amount of indigestible fiber.—When adding bulk to a ration, it should be done by adding foods that are readily

digestible. Foods that are bulky are likely to contain a large proportion of woody fiber (cellulose), which the animal is compelled to reduce to fineness, and pass through the body undigested. This requires a large and unnecessary expenditure of energy, and makes impossible the rapid metabolic changes that are necessary with the laying or growing fowl.

Part of the ration should be of whole grain and part of ground feed.—Fowls are essentially grain-eaters. They prefer whole or cracked grain to the ground grains. The most rational system of feeding fowls requires that both whole grain or cracked grain and ground feed should be supplied. The whole grain insures the activity of the body in grinding the grains and makes over-feeding less likely. It also has the advantage of inducing fowls to take exercise in hunting for the grain, which should always be scattered in a deep litter of straw. Ordinarily, if left to their own choice, with free access to both whole grain and ground feed, fowls will consume one-third to one-half ground feed, depending largely on the nature of the mixture.

All of the common grains, with the exception of peas, have a wide nutritive ratio. The ground feed mixture, therefore, should be made narrow. In order to do this, a little oil-meal or alfalfa meal may be used to advantage. Generally, however, the meat food will have to be depended on to narrow the ration. [See page 107.]

It seems necessary to feed at least one-third ground grain in order to supply the fowls with readily available nourishment, especially when they are in heavy laying. Fowls do not seem capable of grinding the whole or cracked grain rapidly enough to satisfy their needs, except during the season when they are least productive. Wheat is the most desirable of grain foods. Corn, however, because it is usually cheaper, should be used largely throughout the United States. Heavy oats are next to be preferred; light oats are to be avoided. Peas, although one of the best foods for poultry, cannot be used extensively because of scarcity and high price.

For ground feeds, the wheat by-products—bran and middlings,—and corn meal and ground oats are the most desirable. Gluten meal or gluten feed is being fed successfully in a limited quantity in connection with other ground feeds. As a rule, fowls do not eat oil-meal so readily as the other ground feeds, but because of its richness, it is desirable to include not to exceed 5 to 10 per cent of it in the ground feed ration. Cottonseed meal has not proved satisfactory.

Meat in some form should be a part of every ration, whether for raising the young, or for feeding the mature stock for production or fattening.—A pound of protein in the form of meat appears to be more valuable than a pound of protein in any other class of foods. Meat should form at least 10 to 15 per cent of the total food consumed each day, depending on the kind of meat and other food and their composition. Beef scraps, because of high protein content and good keeping qualities, must be mainly depended on. Skimmed milk at 15 to 20 cents per 100 pounds is probably the most desirable of all meat foods, to be fed either in the liquid or as pot cheese. Sour milk is more desirable than sweet, but it is not well to alternate sour milk and sweet milk. Green cut bone is very desirable for variety, and one-half ounce may be fed each day per fowl in addition to other meat foods. Milk albumen has not been sufficiently tested to warrant a recommendation.

Green food should form some part of the daily ration.—The chief value in feeding green food is the fact that the succulence and medicinal qualities assist in the digestion of other foods and tend to promote health if judiciously fed. The most desirable green food is clover pasturage. Cut clover, fed either dry or steamed, furnishes excellent green food for winter use, but lacks in succulence. The mangel beet, when fed in limited quantity, is perhaps the best winter green food. Cabbage, if fed in a reasonable quantity, does not appear to injure the flavor of the product and is much relished by all kinds of poultry.

Grit forms an indispensable part of a poultry ration.—Experiments at Cornell University have proved that grit has a double function, namely to grind or crush food in the gizzard and to furnish lime. Most of the grits on the market contain little or no lime. Cracked oyster shells or mortar are the chief sources of lime. They also meet the need for grinding material.

The foods should not injure the flavor or the color of the product.—It has been demonstrated by several experiments and is well recognized in practice that certain foods influence the color of the yolk of the egg, the fat of the body, the skin and the feathers. Yellow corn and clover impart a deep yellow color pigment. Wheat, oats, and especially buckwheat, produce a very light colored pigment. Experiments at Cornell University show that onions and fish, except when fed in excess, do not impart a marked flavor to the eggs. Cabbage fed in excess, in two carefully conducted trials, did not produce undesirable flavor that could be detected even in the raw egg.

The cost of the ration should be considered.—The fact that the principal poultry foods vary in cost from time to time, according to the supply and demand, makes it desirable that rations be varied somewhat to suit the market conditions. It is seldom necessary to feed largely of the most expensive foods. Generally, the by-product feeds are less expensive to purchase per pound of food nutrient than the whole grains. This is particularly true in the case of wheat, buckwheat and corn. Wheat bran, wheat middlings, buckwheat middlings and gluten meal, by-products respectively of the grains mentioned, should be used largely.

Special types of poultry-feeding.

Fowls appear to need more available protein and fat during the molting period than at other times. This seems to be due to the need of supplying nitrogen for the growth of feathers and fat, to be readily converted into heat. The practice of

"forcing the molt" has not met with universal approval. It is reported to have proved satisfactory in inducing fowls to molt earlier in the fall, and to lay more eggs during early winter than they otherwise would. Three experiments at Cornell University with one-, two- and three-year-old Leghorns, indicated that it did not pay to "force the molt." It is possible that forcing the molt may produce different results with other breeds of fowls. In the light of our present knowledge, the best general practice appears to be to furnish the most favorable conditions for production at all seasons of the year, and never to check production with the expectation of again starting it at a stated time. It is easier to stop hens laying than it is to start them.

Feeding according to age.

The system of feeding must be adapted to the age of the fowl. Young fowls naturally utilize their food in the production of new growth and energy. Mature fowls, having completed their growth, utilize their food in production. Old fowls, having completed their development and their years of greatest production, have a tendency to use their food in the production of fat.

Feeding fowls during different seasons of the year.

Theoretically, more heat-forming foods should be fed during the winter season than at other times; that is to say, wider rations are required during the cold weather, and narrower rations during the warm weather. Generally this is accomplished by increasing or decreasing the amount of corn fed during different seasons of the year, corn having a wider nutritive ratio, and therefore, presumably, being a better producer of heat and energy, than most of the other feeds.

Feeding sitting hens.

A broody hen needs less food than at any other time of her life. As a rule, she is mature, non-productive, non-active and simply requires a maintenance ration. This should be largely of whole grain with a limited amount of vegetable food, if any, and only a small amount of meat. The object is to prevent the development of the ovaries by too large a supply of readily digested nourishment.

Breaking up broody hens.

The broody hen should be fed with a view to inducing egg-production in the shortest possible time. It should be fed, therefore, the most attractive and best egg-producing rations.

The feeding of the breeding stock.

In feeding the breeding stock, the object should be to prevent over-feeding, especially during the non-productive seasons—fall and early winter. As a result, a large egg-yield cannot be secured. The rations should not be too narrow, and thus produce a phlegmatic condition, nor too fattening, and cause sluggishness and fatty degeneration, either of which would come by over-feeding of rich rations. A limited amount of meat, whole grains fed in a litter to induce exercise in the open air, and a limited amount of green food with an abundance of bone and oyster shell, should be fed.

Feeding the different breeds.

The heavier and the more sluggish the breed, the greater is the tendency to become fat, and, therefore, the greater is the need of proper methods of feeding, which will compel exercise and prevent over-eating. The lighter and more active breeds apparently can be fed a wider ration with less danger of over-fatness than can the heavier and more phlegmatic breeds. The fine art of feeding consists in furnishing the right kind of foods in such a manner that the fowls can be kept in the best physical condition. This means that the fowls must have some surplus fat in the body. A poor hen cannot lay. A very fat hen may become so sluggish that death will result from fatty degeneration. The fowl that is in the best laying condition always has a large amount of surplus fat in the body. How to furnish the available nourishment to meet the needs of egg-production, and at the same time prevent the fowls from becoming too fat, is the problem in feeding. In a word, it consists in feeding a well-balanced ration in such a manner that the appetite shall be kept good, which means that once a day fowls should come eagerly for the food, preferably in the morning, and once a day have all the food that they can possibly consume, preferably at night.

Feeding turkeys.

Turkeys are grain- and insect-eaters. They are the best of foragers. When very young, they are the most delicate of poultry. After they "throw the red," i. e., show their comb, which they do when they get their first full plumage, they are among the most hardy of poultry. The young, therefore, need great care when they are reared artificially and in large numbers.

The feed for the first few days should be largely of bread and milk, made crumbly and mixed with "pot cheese" in the proportion of three of the former to one of the latter. To this should be added a little chopped onion. This mixture should be fed two or three times a day, as much as they will eat. Once or twice a day they should be given finely cracked corn, wheat and oatmeal, mixed in about equal parts. The proportion of bread and milk should be decreased after the second week, at the same time finely cracked grains and pot cheese being fed more largely. Fine grit and charcoal should always be available. Water should be provided in a receptacle where the young turkeys cannot become wet. Gradually, as the turkeys grow, coarsely cracked or whole grain may be used, and a good grade of beef scrap gradually substituted for the "pot cheese." The latter, however, is to be preferred.

A board enclosure, one foot high and twelve or fourteen feet square, placed around the coop on closely cropped, clean grass sod, makes a desirable place to start young turkeys. Until they have thrown their wing and tail feathers, so as to fly

over the board, they cannot be trusted to roam far from the coop. They should not be allowed at any time to run in the wet grass, as they are easily chilled. More young turkeys are lost through exposure than through improper feeding.

When turkeys are permitted to roam the fields, which they do in most cases, they will get a large part of their living. In order to make certain that they are well fed, and also to induce them to return, they should always be fed grain at night. This usually will be corn, although wheat, oats or peas may be added to advantage.

Turkeys, young or old, should never be permitted to run with the young or old of the domestic fowl. They are not so lively, rugged or intelligent as chickens, and therefore suffer when compelled to compete with them for food.

When fattening turkeys for market, it is better to permit them to continue on free range. They worry in confinement and will not eat well. They should be fed all the whole corn they will eat at night. In the morning they should be given corn meal, middlings and meat scrap, mixed with sour skimmed milk. This mixture should be about in the proportion of 60 pounds of corn meal, 30 pounds of wheat middlings, 10 pounds of beef scraps, and enough sour skimmed milk to make a thick dough. Turkeys may be finished during the last week by placing them in dark coops and cramming them by hand with pellets consisting of two parts of corn meal, two parts of ground oats (shucks out), one part of wheat middlings, and one part of meat scraps, mixed with sour skimmed milk.

The breeding stock should be permitted to roost in the open air, but be protected from the storms and winds. This exposure requires fattening foods to enable the turkeys to keep warm. Whole corn alone is too fattening. Oats and peas should also be fed. During the breeding season, one feeding a day of ground feed, which contains a liberal amount of meat, should be given. A good mixture for this purpose is equal parts, by weight, of corn meal, wheat bran, wheat middlings, ground oats and meat scraps, mixed with sour or sweet skimmed milk. Oyster shells and water should be available at all times.

Literature.

For references, see page 527.

Feeding Water-fowl.

By *Geo. H. Pollard.*

The most common water-fowl raised in domestication, and the ones receiving attention here, are ducks and geese. While these are commonly considered to be water-fowl, because they delight to be in the water, the accessibility of a body of water for swimming purposes is no longer held to be necessary in raising them.

Feeding ducks.

Under natural conditions, ducks feed on water-grasses and roots, and on the lower animal life, which inhabits low lands and wet places. Under the influence of domestication, their habits have changed somewhat, although their instincts are much the same as in the wild state. The best feeder is the man who considers these facts and works as much as possible along natural lines.

The feeding of breeding birds necessarily differs somewhat from the feeding of market stock. In either case, the ration should be made up of such of the accessible grains and supplies as will furnish a palatable mixture at a minimum or fair cost. Ducks are voracious feeders, and, in order to save a profit, waste both in cost and in spending must be carefully looked after. When breeding birds have a water-run, coarser and richer food may be fed more safely than when they do not, as the extra exercise the ducks take will utilize the materials more fully. When both free range and water-ways are to be had, either whole corn, wheat, oats or barley, or a mixture of any or all, may be fed, and the ducks will "balance the ration" for themselves and do well. If there is a profitable market for the eggs, either for table or for incubation, it is well to provide a supply of good beef scrap and feed it in a box or hopper, allowing the ducks to help themselves. A constant supply should be kept before them, or it may be given in such quantities as will produce the results wanted most economically.

When kept in confinement, and the earliest and greatest possible number of eggs are wanted, soft food should be fed night and morning, and a light feed of hard grains given in the middle of the day. A good mixture is three parts of corn meal, two parts of wheat bran, one part of red-dog or low-grade feeding flour, one part of cut alfalfa, cut clover, or vegetables, such as cabbages, turnips or beets cooked or suitably chopped, and one part of best beef scrap, or an equal quantity of dried and prepared fish. When fresh fish can be procured, it may be fed raw or cooked, if made fine enough. The mixture is moistened to a crumbly consistency with cold water. Night and morning, as much of this or some similar mixture as the ducks will clean up within fifteen or twenty minutes should be supplied. If preferred, this mixture may be fed dry, in which case it should be kept before the ducks all the time in boxes or hoppers. Obviously, if fish is used it must be dried and prepared. This method saves much of the labor, and the labor cost is one of the heaviest items in the production of ducks.

Drinking-water should be within reach at all times. Owing to the habit of washing down their food, ducks should never be fed without a plentiful supply of water easily available.

When there is green range, no clover or vegetables need be added to the ration. Sometimes it pays to feed more meat and meal in the laying season and less in the dry months. Gluten, hominy chops, or any of the various food-stuffs, may be substituted in the above ration, and a close watch of effects will determine which is the most profitable under the special conditions of the feeder. The main point to keep in mind is that full feeding

of satisfying feeds is generally the most profitable, and in this respect the freest spender is the best saver.

Young ducks intended for market must be pushed from hatching to killing time. All the profit to be made depends on quick growth. The leading factor in this growth is a proper supply of animal food in some palatable form. High-grade beef scrap is the main dependence of most growers. Properly prepared fish will answer as well. Some growers object to fish, on the ground that it flavors the carcass of the duckling. Unless it is an oily, rancid preparation, it will seldom cause such trouble.

Ducklings should not be fed until they are thirty-six to forty-eight hours old. The first feed may be a mixture of two-thirds wheat bran and one-third corn meal, moistened with water or milk, and with a raw egg stirred in with each quart of the grain. It is moistened only enough to make a slightly damp, crumbly mass. A little sand or prepared grit is added, and this feed is kept before the ducklings for forty-eight hours. The attendant must be careful to renew it before souring, and feed only sweet food. Clean water must be provided in such kind of fountain or vessel as will let the ducklings get their bills and heads but not their bodies into the water. Water should be kept before them night and day, until killing time. To prevent their playing in it, some growers water only at feeding time after the ducklings are a few days old. They should not be allowed water-runs, if the quickest growth is wanted.

By the time the ducklings are one week old, they should be getting as much as 5 per cent of beef scraps, and three parts of wheat bran, and two parts of corn meal. The proportions should be changed gradually, until at six weeks old the meal and bran are equal, and the beef scrap amounts to 15 per cent of the whole. After the first few days, the feed should be given four times a day until six weeks old, and then three times until the ducks are marketed. On this simple ration, ducks can be carried to a good market condition at ten weeks old. If there is too great looseness of the bowels, the proportion of scrap should be reduced for a time. Many persons feed a greater proportion of meal the last two or three weeks. Green food is greatly relished by the ducklings, but too much must not be fed, or the skin will become yellow; the best markets prefer white-skinned ducks and geese. Wheat bran helps greatly in this respect, as well as in growing the frame. It is well to provide a constant supply of crushed oyster shell, and gravel or grit.

The rations given for both old and young birds, while general, are sufficient, although they may be varied greatly to suit conditions and the cost of different grains. Dry-feeding, or the feeding of a mixture of ground grains in a dry state, is yet in an experimental stage. The success of this system, which is coming into general use with other poultry, would revolutionize the business of growing market ducks. The grain mixture is left before them at all times, and the hoppers or boxes are filled only as fast as emptied by the ducklings, which may be once or twice a week if the holders are sufficiently large. There is yet some question whether the ducklings can be grown as big in ten or twelve weeks, at which age the pin-feathers start and they should be dressed. If permitted to run three or four weeks longer, they will gain one to two pounds in weight and will again be in condition for marketing. On the later hatches, at least, it seems as if the great saving in labor and the gain in weight would more than pay for the extra four weeks of keep.

Ornamental ducks and pet stock may be fed anything they will eat, save a too full ration of fattening foods. When only a few are kept, the hard grains will answer for the old stock most of the time, and the young may have any simple mixture of soft food. Green food may be given as freely as convenient. As quick growth is not a necessity, there is no need of the great forcing which must be given market birds.

Feeding geese.

When given the opportunity, geese graze almost as freely as cattle. This fact leads many persons to suppose that a grass range is all that is necessary for growing market geese. This is a mistake. Breeding geese will do well on a grass range, especially if a low meadow or marsh with considerable water. In winter they should have a moderate grain feed and a liberal allowance of roots, cabbage, or other succulent food, but not too much of a fattening nature. The closer the confinement the more care is necessary in this respect. Geese fatten readily, and the breeding stock should not be permitted to put on too much weight.

At about laying time, the attendant should begin to increase the feed and give twice a day a liberal ration, containing considerable animal food in some form. The ordinary duck foods will answer. After the grass has a good start, one full feed of grain a day will do if the geese have sufficient range.

Geese wash down their food much the same as ducks, and water should always be accessible at feeding time.

Goslings do best when they have a limited range on fresh, tender grass. This they eat freely, and they may be grown on it after a fashion; but they will never make the size, and will fatten less rapidly than when fed a proper grain ration. On grass range, and given a food similar to that for young ducklings, and fed as often, they will grow rapidly and make weight faster than any other poultry. When grass-fed geese are fattened for the market, they may be fed corn meal with 10 per cent of beef scrap added. This may be scalded or wet with cold water. Whole corn may be fed once a day. It usually takes about four weeks to fatten them properly. Gravel or grit in some form should always be within reach.

Ornamental and fancy geese may be fed the same as ornamental ducks, and for the same reasons.

Literature.

For references, see page 527.

Fattening Poultry. Fig. 531–539.

By *W. R. Graham.*

Much of the poultry offered for sale on our markets is thin in flesh and poorly dressed,—a testimony to the lack of skill or care on the part of the grower. The majority of the chickens now sold represent a waste. Not only are they inferior in quality and quantity of flesh, but they are very unsatisfactory to the buyer. It is the purpose of this discussion to deal almost entirely with the fattening, or perhaps one should say the "fleshening," of chickens, and to suggest how it may be accomplished. What applies to chickens will apply largely to fowls also. As with other classes of live-stock, much depends on the condition of the subject that is to be fed, whether it is old or young, large or small, bred from meat-producing breeds and of a strain in which this habit is well established, or from a strain that has no particular ability to put on flesh with economy.

Fig. 531. Fowl with well-developed breast.

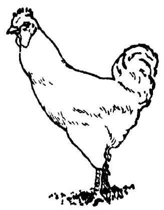

Fig. 532. Fowl with very poor breast development.

The type for meat-production.

The writer has paid considerable attention to the question of type for meat-production, and begs to submit the following discussion taken from Bulletin No. 151, published by the Ontario Department of Agriculture, Toronto:

"When looking over dressed poultry in some of the exporters' shops, I have often thought how easy it would be to improve the appearance of much of the ordinary poultry, and some of that which is specially fattened, if the birds were bred to a proper type. I have spent much time in examining different types of birds, alive and dressed, and in observing the feeding capacity of certain types; but it would take years to arrive at definite conclusions on these points. I am of the opinion, however, that one of the most important things to be sought is constitution. This may have no actual market value, but it certainly has much to do with the bird's ability to grow and put on flesh. What we want is a good feeder and an economical producer. Generally, a bird with a short, stout, well-curved beak, a broad head (not too long), and a bright, clear eye, has a good constitution. I have noticed that when a bird has a long, narrow beak, a thin, long comb and head, and an eye somewhat sunken in the head, it is usually lacking in constitution. Such a bird is likely to have a narrow, long body and long legs, on which it seldom stands straight. There are some exceptions to this rule; yet, generally speaking, if a bird has a good head the chances are favorable for a good body; and if it has a poor head the chances are against it. I have frequently noticed in the rose-comb breeds, such as Wyandottes, that a good-shaped one is seldom found with a long, narrow comb.

"The neck should be moderately short and stout, indicating vigor. The breast is the most important point in a market chicken. It should be broad and moderately deep; and if broad, it will present a fine appearance and appear well-fleshed. It is quite possible that a broad, deep breast will carry more meat than a moderately deep breast of the same width; yet there is no doubt that the latter will present much the better appearance, and sell more quickly and at a higher price in the market. The breast-bone should be well covered with flesh to the very tip.

"When considering the length of the breast, we must try to have it come well forward (Fig. 531), and not be cut off at an angle, as in Fig. 532. The body, in general, should present the appearance of an oblong when the head, neck and tail are removed. We frequently see birds that are very flat in front, and cut up behind, as in Fig. 533. Chickens of this class have a very short breast; and if the breast happens to be deep, as it is in this bird, the chicken will have a very poor appearance when dressed, as it will show a marked lack of width and length of breast, with excessive depth. Notice that the head is narrow and long, the body is narrow, the eye is bright but slightly sunken, the legs are long and not straight under the body. In Fig. 532, observe the very flat breast, the length of back, the long neck and head, the narrow comb, the sunken eye, and the length of legs. The breast comes fairly well back, but not well forward. In Fig. 531, the bill is short and stout, but not so well curved as it should be. Note the breadth of head, the prominence and brightness of the eye, the short, stout neck, the great width of the breast, the fulness caused largely by the breast-bone extending well forward, the short, stout legs (straight under the body), and the width between the legs. There is an expression about this chicken that indicates health and the essence of vigor.

Fig. 533. Fowl that is flat in front and cut up behind.

"The back should be broad, to give lung and heart capacity; and the width should extend well back to the tail-head. We do not want the wedge-shaped back, as seen in some fowls that have great

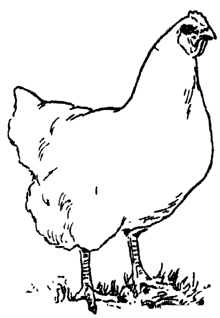

Fig. 534. A good market type of fowl.

width at the shoulders and taper rapidly toward the tailhead.

"It is much easier to get good-shaped market pullets than good cockerels. The market demands a five-pound bird when dressed, and farmers have gone into raising big chickens. To that end they are asking for large, overgrown cockerels, of excessive depth, for breeders; the result is that we get dressed chickens weighing four to five pounds each, that have immense, high breast-bones and very long legs. These are not attractive to the buyers, and they sell at less per pound than plumper birds. For example, if given two birds of the same width of breast, one is one and one-half inches deeper in the breast than the other. The result will be that one bird will look plump and sell rapidly, while the other will lack in plumpness and be slow in selling. This lack of plumpness can be bred out by using such males as that shown in Fig. 531. We like to have birds as well built as we can get them, and Fig. 531 is as near the ideal market chicken as we have in the breed which he represents. The hen seen in Fig. 534 is a good market type. Note the width and fulness of breast. As a breeder, she is a little fine in bone, and rather too small. She has, however, that blocky appearance which is desirable. Fig. 535 represents a cross-bred chick (sire, Buff Orpington; dam, Houdan). Note the length and fulness of the breast; also good beak and eye. Fig. 536 is a picture of a ten-weeks-old son of the male shown in Fig. 531. You will observe the same general characteristics as seen in the father—fair beak, good eye, excellent breast, both as to length and width, without excessive depth. The thigh is also medium in length. Fig. 537 represents the long, narrow sort. Note the long beak, the narrow head, the sunken eye, the long neck, and long, crooked legs. When dressed, his appearance will not be pleasing. Fig. 538 shows a good head throughout, very full and wide breast, and legs that stand well under the body and well apart. This bird is of the type we like to feed in the fattening crate."

Fig. 536.
Young son of fowl shown in Fig. 531. Note resemblance of characters.

The question of size and age have to be decided largely by one's market. It is very little use to try to satisfy a buyer with a four-pound chicken when a six-pound one is wanted. It is the writer's experience that healthy, thrifty birds of such breeds as Plymouth Rocks, Wyandottes, Orpingtons, make most economical gains when they weigh three to four pounds each, or at an age of say three to three and one-half months. By special feeding for three to four weeks, the birds will easily dress four to five pounds each. Large birds, weighing six to seven pounds, cost more to produce a pound of gain. One need not, under any consideration, expect rapid gains or fine-appearing dressed poultry from diseased or stunted stock.

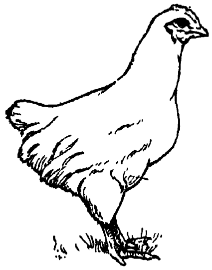

Fig. 535.
A cross-bred chick, showing length and fulness of chest.

The fattening-pen.

The fattening-pen should be dry and, if possible, well ventilated and free from drafts. The birds that are cooped must not be placed in direct drafts or many will take cold. An open shed, with three sides tight, makes a good place for early fall or summer fattening, but for late fall more protection is required to secure the best gains.

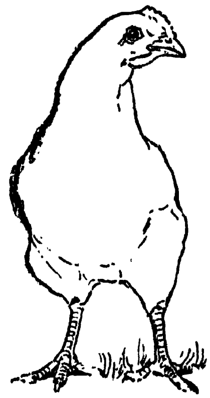

Fig. 538.
A good type of fowl for fattening.

Crate-feeding vs. loose pen-feeding.—For a number of years the writer has conducted experiments with chickens in crates and in loose pens. He has tried six different feeders, with varying results. With some feeders, equally good results were secured with birds in crates as in loose pens. In the case of two feeders in particular, the birds could not be fed to advantage in loose pens as compared with crates. With one feeder, on the other hand, slightly better returns were secured in some cases with birds in pens. The majority of buyers of chickens seem to think that the crate-fed birds are much superior to those fed in loose pens. The writer prefers to feed birds in crates, for the reason that it takes less room. They are fed with less expenditure of labor, and a more even profit is returned. However, there are many persons who can get good results from feeding birds in box-stalls and like apartments.

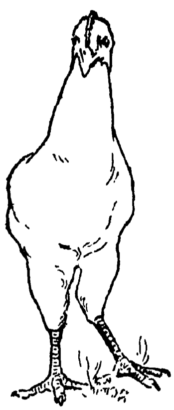

Fig. 537.
A long, narrow type of fowl.

Construction of fattening crates.—A fattening crate is usually made six feet six inches long, eighteen to twenty inches high, and sixteen inches wide. It is divided into three compartments, each holding four to five birds, according to the size of the chickens. It is made of slats, except the ends and partitions between the compartments, which are solid wood. The slats on the top, bottom and back run lengthwise of the coop, while those on the front run up and down. They are usually one and one-half inches wide and five-eighths inch thick. Those in front are placed two inches apart to allow the chickens to put their heads through for feeding. The slats on the bottom are placed about three-fourths of an inch apart, so as to permit the drop-

pings to pass through to the ground. Care should be taken not to have the first bottom slat at the back fit closely against the back. An opening at this point prevents the droppings collecting and decomposing. The slats on the top and back are usually two inches apart. There is a small V-shaped trough arranged in front of the coop for feeding and watering the chickens. The trough is two to three inches deep and is generally made of three-fourth-inch lumber.

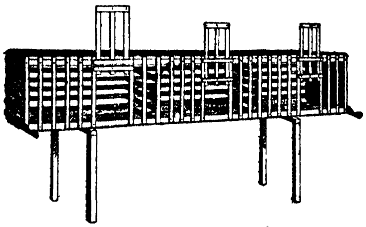

Fig. 539. A single crate or coop for fattening fowls.

Very fair coops may be made from old packing-boxes, by taking off the front and bottom, and substituting slats in their places. (Fig. 539.) When fattening chickens inside of a building, it is well to darken the building and keep the birds as quiet as possible.

Feeding.

It is somewhat difficult to write clearly on this subject, as the writer's experience has been largely in the production of white-fleshed chickens for home and export markets. The yellow-skinned Plymouth Rocks and Wyandottes can be made fairly white if fed on such foods as milk, oats and buckwheat. Some years ago, the writer took birds that were full brothers and fed some on such foods as the above, while others were fed yellow corn, boiled pumpkins or red carrots. When the two lots were killed, one lot was nearly white in color of skin while the other was yellow. The object in feeding is not only to make flesh and fat, but also to soften the muscles. The softer the muscles, the more tender; and a tender, juicy chicken that carries plenty of flesh pleases the consumer.

Sour milk has given better returns than sweet milk. The sour milk appears to aid digestion and the birds keep in better health when it is fed. When milk cannot be had, whey is useful, if some animal meal or beef scrap is fed with it; not more than 10 per cent of the ration should be beef scrap. If nothing but water is available, the meat meal may be increased to 15 per cent.

The best grain ration is composed of two parts of very finely ground oats, two parts of finely ground buckwheat, and one part of ground corn. This mixture is by weight, not by measure. To the ground grain, sufficient sour milk is added to make the mass about the consistency of gruel, or so that it will drip from a spoon like pancake batter. If the milk is thick, it will take nearly two pounds of milk to one of grain. A little salt is added two or three times a week. The writer feeds not more than one ounce to one hundred birds. Should the birds show signs of feather-pulling, the salt should be slightly increased. Other grain mixtures give good results. The food must be palatable and the grain finely ground.

If there is any secret in fattening chickens it is in the method of feeding. When the birds are first put in the crates or shut in the pen to be fattened, they should not be fed anything for the first twenty-four hours, or until such time as their appetite becomes keen. During the first week they should not be fed much more than one-half of what they would ordinarily eat. The writer usually begins by feeding one dozen chickens not more than eight to twelve ounces of grain mixed with about twice as much milk. After the first week the ration is gradually increased until the appetite is fully satisfied. Should the feeder fully satisfy the appetite of the chickens during the first three or four days, or even the first week they are in the crate, in all probability the birds will do very poorly. A feeder with good judgment at no time will over-feed his birds. He should feed all they will eat after the first week, but should stop short of the full capacity. If the feeder can accomplish this, he will be able to get on an ordinary Plymouth Rock, Wyandotte, or what might be called a general-purpose chicken, one and one-half to one and three-fourths pounds in three weeks' feeding. Cockerels should be fed two weeks or more before they are killed and sold. The writer's experience tends to show that if chickens can be purchased at eight cents per pound, live weight, and sold plucked, but not drawn, for twelve cents per pound, a return of fifty cents to one dollar per hour can be secured for the time it takes to feed the birds, allowing four to five cents each for plucking, one dollar and thirty cents per hundred weight for grain, and twenty cents per hundred weight for skimmed milk.

Literature.

For references, see page 527.

Capons and Caponizing. Figs. 540, 541.

By *T. Greiner.*

A capon is a castrated male fowl. The act of caponizing consists in the removal of the testicles of a cockerel, in order that he may grow larger, become more gentle, and fatten more readily than he otherwise would. The castrated cockerel, or capon, grows somewhat plumper and fatter, even if not much heavier, than the unaltered male, and retains much of the tenderness and juiciness of flesh and the higher meat value of the spring chicken. Surplus cockerels of the larger yellow-skinned breeds, as the Brahma, Cochin, Wyandotte, Plymouth Rock, Indian Game, Rhode Island Red, and the like, may be, and are now to some extent, turned into capons and sold in our leading markets at prices ranging from sixteen cents to over thirty cents per pound. The Langshan, although white-skinned, also makes a good, large capon. The dressed capon of the Brahma, Langshan, and other large breeds often exceeds ten pounds in weight.

The equipment.

The first thing necessary is a good set of instruments. There are a number of different styles on the market. One of the best and handiest for the

beginner (Fig. 540) consists of a lance, spreader, steel hook, probe, a pair of nippers or tweezers and a canula. For the removal of the testicle, a piece of fine pliable wire is better than a horse hair (from the horse's tail). Little bits of sponge are used to mop up any blood that may gather around the incision, or in the interior of the bird while under the operation. There is little cause for nervousness or excitement on the part of the operator, for the operation does not appear to cause much suffering or inconvenience to the bird. If a blood-vessel is accidentally ruptured, as may happen in a small percentage of the cases, the bird will quickly die under the operator's hands, and may be used for the table.

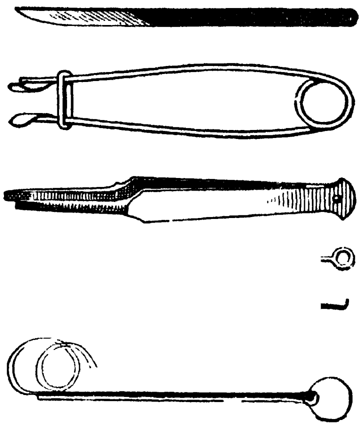

Fig. 540. A caponizing set. Beginning at the top: Lance, spreader, nippers, probe, steel hook, canula.

The operation.

The operation is simple, and may be learned from printed instructions without actual practical demonstration. If the beginner has a chance to see it performed, all the better. The testicles are removed through an incision, about an inch in length, made between the last two ribs (those next to the hip, Fig. 541). The expert operator usually takes both testicles from one opening, on the left side. But to undertake this task usually means failure for the beginner, who will find it far less difficult, and less inconvenient and dangerous for the bird, to cut both sides, taking one testicle from each side.

To prepare the cockerel for the operation, let him go without food for thirty to thirty-six hours. This is necessary so that the bowels will be empty, allowing the testicles to be seen and removed more easily. The beginner must be able to see what he is doing, and he therefore needs good light,—subdued sunlight. The hours nine to eleven in the forenoon and two to five in the afternoon, during July, August and early September, are the best. The expert can caponize on dark days, and at any hour of the day. He knows the exact location of the organs and can find them without being able to see them plainly. The beginner must see them for safe operation. During the noon hours on a clear day, the sun's rays being intercepted by the operator's head, so deep a shadow is cast that nothing inside the fowl can be seen to advantage. With the sun nearer the horizon, say half way between there and the zenith, the table or barrel on which the bird is fastened may be tilted enough to catch the direct sun rays through the incision so that the beginner can plainly see the interior organs.

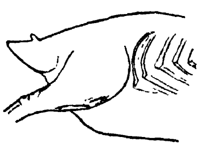

Fig. 541. Diagram of ribs. Dotted line shows where to cut.

A rather lean bird, weighing two pounds or less, is a better subject for the operation than a fleshy one of much heavier weight. Fasten the bird on its left side, in any convenient way, on a plain, light operating table, or on the head of a barrel. A good, simple method is to loop a cord around the wings, near the body, and have a weight fastened to the free end, suspended from the side of the table or barrel. Another cord is looped around the legs just above the feet, with a weight hanging down on the other side of the table or barrel. This will hold the victim firmly in proper position. Pluck the few small feathers that are found over the last ribs close to the hip, pull the skin toward the hip with the left hand, while the right hand, holding the lance, makes the incision with a quick but careful dip. There is seldom much bleeding. Any blood may be mopped up with a sponge moistened with warm water or a very weak solution of carbolic acid. With healthy birds there is no danger from blood poisoning. Insert the spreader to keep the cut surfaces apart. With the fine steel hook, carefully tear the thin membrane (peritoneum) that covers the intestines and bring the interior organs to full view. If the testicle is not already in plain sight, introduce the small ring of the probe and push the bowels aside until the object sought after is found. Next slip the fine wire loop of the canula around the testicle, and by twisting and pulling the wires, detach that organ and pull it up through the incision. The cord or membrane to which it is attached may have to be severed, say an eighth or a quarter of an inch from the testicle, with the lance. Remove the spreader and let the skin slip back over the wound. Then turn the bird over on the right side, and go through the same proceeding as before on the other side. Loosen the capon and mark him in any way desired, if by nothing more than by cutting off the end of one of his toes. Give him his freedom and plenty to eat. He will have a ravenous appetite and grow rapidly, and finally get very fat. The wound heals over perfectly in less than ten days, so that only a light scar is left.

For a week or so after the operation, capons are usually given soft food only, and had better be kept in a yard by themselves. If wind-puff (a gathering of air under the outer skin) occurs, it is easily relieved by pricking the skin with a sharp-pointed sterilized pen-knife. Capons may be kept until the winter or spring following, and then killed for use or sale. At times they have been used for brooding newly hatched chicks.

Literature.

Dow, Capons and Caponizing, Clarence C. DePuy, publisher, Syracuse, N. Y.; Greiner, Capons for Profit, Cyphers' Incubator Company, Buffalo, N. Y.
[For further references, see page 527.]

Incubation and Brooding. Fig. 542–546.

By *Charles A. Cyphers.*

On commercial poultry-farms, the artificial incubating and brooding of chicks is an accepted practice. It has long since passed the experimental stage. It has contributed no small part to the development of an extensive commercial poultry industry. A knowledge of the principles involved is a necessary part of a poultryman's equipment.

Chickens are grown artificially because it is difficult to get enough broody hens to hatch the eggs in large numbers, and hens do not sit during the months when it is desired to raise the birds. Small chickens are raised through the winter for broiling and frying, and large roasting chickens or capons are hatched and reared through the fall and winter, to be marketed in the spring, when the supply of soft roasting chickens produced under natural

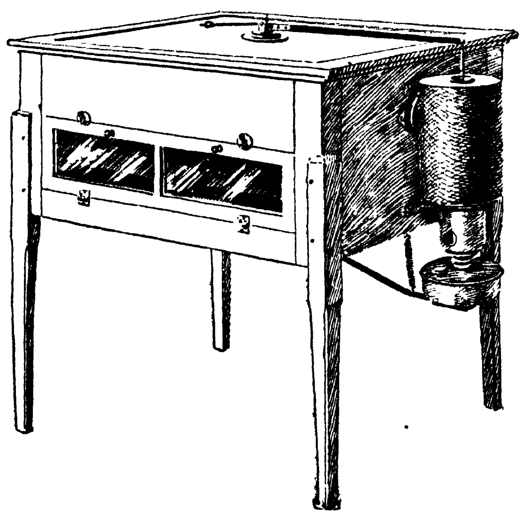

Fig. 542. **A modern incubator, small size.**

methods during the spring and summer has been consumed. These winter and spring birds bring high prices. Large producers of market eggs hatch and rear their birds artificially in the early spring months before the hens begin to sit. By so doing, they are able to get their birds developed and to lay in the early fall. Market eggs bring high prices in the fall and winter, because the larger number of hens are still hatched under natural methods in the late spring and early summer, and they do not begin to lay until spring, leaving a period in the fall and winter when there is a short supply.

Incubation.

The essential feature of incubation is to apply to the egg a constant warmth of about 102° Fahr. In nature, we find the parent bird sitting on the eggs, imparting to them the warmth of the body. The only exception we find to this in nature is in the Megapodes, or Mound-birds, which are native to the Philippine islands, the islands of the Indian archipelago and Australasia. A huge mound of decaying vegetable matter is raised, the eggs are deposited vertically in a circle at a certain depth, and the chick is developed with the aid of the heat of fermentation.

There is a theory that the heat of the sun is sufficient for incubation in tropical climates; and the ostrich is said to leave her eggs to be hatched by the heat of the sun's rays alone, when she breeds in the region of the equator. This is a fallacy, however, as a steady continuous temperature of about 102° Fahr. is requisite for successful incubation. The heat of the sun, alternating with the cold of night, would hatch no bird's egg. The ostrich deposits about fifteen eggs in a hollow of the sand, the male bird helps to incubate, and the young are excluded in thirty-five or forty days, according to the species. The body of the parent bird not only protects the egg from the chill of night, but also from the heat of the sun during the day. It imparts its own even body warmth to the egg. [See *Ostrich*, page 511.]

When a fertile egg is laid and becomes cold, the germ remains dormant until heat is applied, when this stimulus rouses the sleeping energy to vital action. The embryo is dependent on an external source for the warmth necessary to its full development. In other words, all vital action requires a certain amount of heat for its due performance, and can continue only within a certain definite range of temperature, within the limits of which it is excited by the additional application of the heat, and depressed by its abstraction. This is no less true of the embryonic life within the incubating egg, than it is with the adult. In the adult, heat is obtained by endowing the body itself with the means of generating warmth, and this heat generated within the body is subject to constant regulation through the equalizing powers of the animal organism. With the developing embryo in the egg, which has no power to maintain its own temperature, and is wholly dependent on external influences for its development, an even temperature of 102° must be maintained for the full period of incubation. With domestic hen eggs, this period is twenty-one days; with duck eggs, twenty-eight days; with geese eggs, thirty-five days. Ostrich eggs require the longest period of incubation, varying from thirty-five to forty days, according to the species.

The origin of the artificial hatching of bird's eggs is obscure. We have authentic accounts of the Egyptian methods as practiced in the twelfth century. Large ovens, or mammals, of sun-dried brick were constructed. These were made large enough for the attendant to enter and work around and handle the eggs. They were heated with smudge fires, and the proper temperature determined by the sense of touch.

The Chinese were among the first to practice the art. The eggs were packed between layers of porous paper, and were placed for the first few days in a closed closet or bin, where they were heated with a charcoal fire. After a certain degree of development of the chick was established, the animal heat generated within the egg was utilized to

effect incubation. This close packing made it necessary to expose the eggs to the air for a short period each day, in order to supply sufficient oxygen to complete the development of the embryo. A day or two before exclusion, the eggs were unpacked and laid on shelves between layers of porous paper until they began to hatch, when the top layer was removed. The rooms in which the eggs were placed were kept warm by utilizing the heat of the sun; and the temperature was regulated by the use of shutters. The art was thus practiced only in warm climates, and its successful performance required long experience; so that the trade was usually handed down from father to son.

Modern artificial incubating and brooding bear but little resemblance to the ancient art. Both the English and French built hatching ovens heated by coal fires about 1770; but portable incubators did not come into existence, as far as we can tell by the patent office records, until 1846. It was not until about 1880 that portable hatching machines came into popular use. In the past thirty years, portable artificial hatchers have been the subject matter for a great many patents. Various contrivances have been perfected for diffusing the heat in the hatching chamber so that all the eggs may receive the same degree of heat; and various regulating devices have been designed for controlling the temperature.

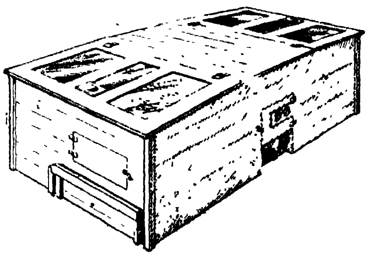

Fig. 543. Double indoor brooder.

The commercial incubator (Fig. 542) or hatching machine has an incubating chamber with heavy walls to insulate it from outward changes in temperature. To diffuse the heat evenly, some manufacturers use a circulation of hot air, while others use a radiator placed in the upper part of the egg-chamber, in which warm water circulates. The air or water is warmed by a small oil or gas heater attached to the side of the incubator. The temperature in the egg-chamber is controlled by a thermostat, which acts on levers and valves to regulate the height of the lamp or gas flame, or to regulate the flow of heated air into the incubating chamber.

The young chick.—After the chicks are hatched they are left in the incubator twenty-four to thirty-six hours to dry and to keep warm. The baby chick is particularly sensitive to the slightest draft. It is thinly clad, has little power of resistance, and cannot keep up its temperature in a cool room. The power of resistance increases with its development. Within the egg, while the embryo is developing, it is immersed in a fluid, and breathes in like manner to a fish, by means of an outer circulatory system called the allantois. A short time before the chick is excluded from the shell, the lungs, which have previously been filled with the fluid, begin to dry out, and the chick has a double circulation. That is, it begins to breathe by inhaling the air contained in the egg at this time into the lungs, while the circulation in the allantois is gradually decreasing. As the chick breaks the shell the circulation in the allantois ceases, and then it depends entirely for

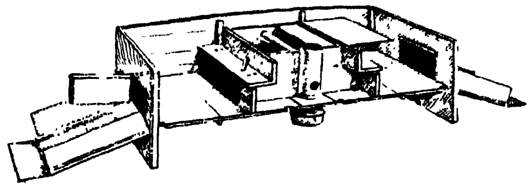

Fig. 544. Interior view of double indoor brooder, ready for hover cover.

the aëration of the blood on the lungs. The change from the aquatic state to the aërial state is rapid, and when the chick is first excluded from the shell the vitality is low. It requires a few days before the circulation has become strong enough to give the chick any resisting force.

Brooding.

To help the chick maintain its temperature when it is artificially reared, not only is it necessary that it should have a place in which it can be kept warm by day, but it must have a place to sleep where the temperature is within a few degrees of the normal blood temperature. For this purpose, an artificial mother is provided, commonly called a brooder. (Figs. 543, 544.) This is usually divided into three compartments: A sleeping compartment or hover; a nursery in which the hover is placed and where the chicks are fed and confined for the first week; and a temperate exercising room. For the first week the hover temperature is kept at 95° to 100°, and the nursery temperature at 80° to 85°. This high temperature enables the newly hatched chick to keep up its normal temperature until its

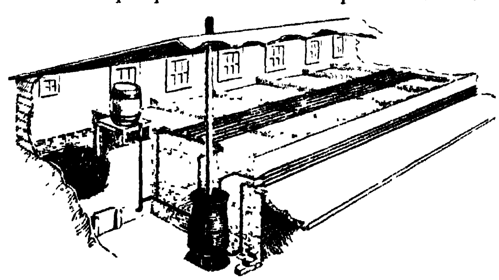

Fig. 545. Interior of brooding house, showing (eight-pipe) hot-water system.

vital forces are sufficiently developed to enable it to withstand a colder temperature. After the chick is six or seven days old, it is given a little more freedom, a little more exercising room, a little colder air to breathe. In this manner it is gradually hardened until it can maintain its own temperature in the outer atmosphere. For a time after the chick is first let out of the brooder, the temperature of the nursery and hover is kept up, so that should the chick feel chilly it may run to the hover for warmth. Because of the liability of the chick

to become chilled if it strays too far from the brooder, it is confined to a space near the brooder for a week or two, and, in the early spring, when the weather is still chilly and damp, for a longer period.

For brooding during the cold winter months, large houses are constructed, heated with hot-water pipes. (Fig. 545.) This heating system is controlled by an electric regulator so that the temperature varies but a few degrees. A large colony brooder that has been in operation is indicated in Fig. 546.

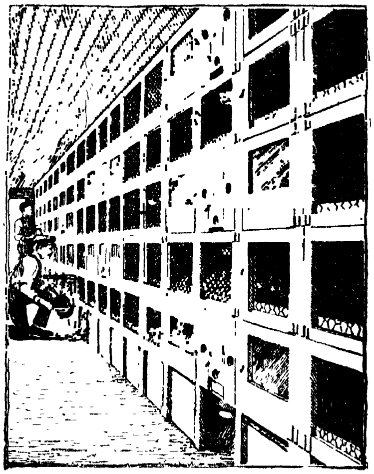

Fig. 546. A fifty-foot nursery brooder, capacity 2,500 chicks.

When growing broilers in the winter, the chicks are confined to a brooding house until they weigh one to two pounds before killing, according to the season and market demands. In growing winter roasting chickens, the cockerels are caponized at about two pounds in weight, after which they are removed to colder houses and grown to large size. In growing laying birds for egg-production, the birds are usually hatched in the late winter and early spring months. When about twelve weeks old they are placed out on grass runs in small colony houses scattered over the fields. Here the birds get plenty of insect life and green food, and with the fresh air and exercise develop strong, vigorous constitutions that will withstand the strain of heavy egg-production.

Literature.

The literature on this subject is meager. For references, see page 527.

Preparing and Marketing Poultry Products, and the Care of Eggs. Figs. 547–551.

By *D. J. Lambert.*

Poultry designed for market, if well fed and cared for from the shell, will take on flesh rapidly when cooped and given extra feed for two weeks previous to killing. An abundance of fat is not so desirable as a plump, well-rounded carcass of fine-grained, soft, tender meat of superior table quality.

Chickens of the same age should be cooped together, four or six in each pen. Coops should be slatted two inches apart to allow plenty of air. The bottom slats may be one-half inch apart. The coops should set up off the ground in a dry, sheltered place. The food should be equal parts of wheat bran, corn meal and ground oats, cooked or scalded, or corn bread, wheat bread and milk. All that will be eaten three times a day should be fed in troughs placed directly in front of the slatted pens. Clean, cool water should be kept constantly before the fowls. No onions or meat food should be given during this special preparation. Uniformity of size is secured by selecting those of the same breed and age.

Young chickens, weighing one to one and one-half pounds each, are termed squab-broilers, and bring best prices in January. As the season advances, the prices decline, and then the demand is for two- to two-and-one-half pound chickens; these are called club-house or Philadelphia broilers. Later and larger market chickens, weighing three to three and one-half pounds each, are sold as fryers at a still lower price. Roasters, ranging from four pounds each upwards, are in constant demand. Capons at the age of eight or ten months usually are ready for market, and weigh eight to twelve pounds each, according to the breed. Fowls are hens one year old and over. Old males are classed as stags or roosters; they are invariably hard in flesh and bring the lowest prices of any market poultry.

Young ducks should be sent to market when ten or twelve weeks old. They are rapid growers, and by that age will be nearly matured and in prime condition, if well fed and not allowed water for swimming. Green geese (goslings ten or twelve weeks of age) are marketable at highest prices. A large goose will also sell well in November and December. Geese are good foragers, subsisting mainly on grass and green food, but will need special grain rations for a month before marketing. Turkeys command best prices at Thanksgiving time. A feed of whole corn at evening when they come home to roost will fatten them rapidly. Turkeys worry in confinement and should not be cooped longer than is necessary.

Methods of preparation.

Coop twenty-four hours previous to killing; give plenty of water to drink, but no food. This will cause the crop to be empty. Nearly all market poultry is now sold with the head on and undrawn, although some states have laws that it must be drawn before being offered for sale. The fast will cause it to look and keep better in the shambles.

There are several methods of killing and picking. The most popular is to hang the bird by the feet by a stout cord suspended from a hook overhead. (Fig. 547.) It is well to have a large wooden button on the end of the cord so that with one twist around the shanks of the fowl it can be fast-

ened quickly. After locking the wings, by putting one over the other, over the back, stun by a blow on the top of the head with a billet of hard wood; then immediately draw a sharp knife across the roof of the mouth, deep enough to pierce the brain. Grasp the wings as soon as possible, and, when the blood begins to flow freely, begin picking, starting with the breast, which is the most important part of market poultry and should not be torn. Do not attempt to pull out many feathers at once; a few each time in rapid succession will clean the bird while warm. One of the barrels underneath is for offal and coarse feathers, and the other for the soft feathers. As soon as the bird ceases to struggle, both hands can be used in picking. A dull knife for removing pin-feathers should be kept handy. All kinds of poultry, except capons, are picked clean, except the wing tips and neck for about two inches from the head. With capons, the feathers are left on the head, wings, tail, and on about two inches of the lower part of the thighs just above the shanks.

Fig. 547.
Fowl suspended for picking.

When the head is to be removed before marketing, the bird need not be stunned, but may be quickly killed by inserting a sharp knife near the throat just back of the ears, turning the sharp edge over against and breaking or dividing the first joint of the neck. This causes profuse bleeding. The bird immediately loses consciousness and loosens its feathers. This is perhaps the most humane method.

If the operator prefers to sit while picking, a large box is provided with its upper edges on a level with his knees. First stun the bird by a sharp blow against a post or a very hard surface. Then hold the bird under the left arm with its head in the left hand and the knife in the right. Open the mouth and cut deep across the roof, going well up into the brain. As soon as profuse bleeding is started, grasp the bird by the shanks in the left hand, lay the breast up across the knees, the head being held between the knee and the box (Fig. 548), and pluck as rapidly as possible with the right hand. While this method allows a sitting posture, the picker has only one hand free to work with, as he holds the bird with the other.

Fig. 548. Position for picking a fowl in a sitting posture.

The cleanest and perhaps the least difficult way to kill a chicken or fowl is as follows: Grasp the bird by the shanks with the left hand and the head with the right hand, with the thumb and the forefinger just back of the head, the second finger being bent around so that its point comes directly under the bird's lower mandible. Straighten yourself up so as to give a steady vigorous pull with both hands until the neck is dislocated. The bird will be easy to pick and all blood will collect in the broken part of the neck.

In some instances, when poultry is sold to a home trade, it is scalded before picking. The kettle or boiler in which the scalding is to be done should be large enough to contain the entire body at once. The water should be at or near the boiling point. The head and shanks should not touch the hot water unless they are to be removed before marketing, for they would then present an unsightly appearance. After the bird has finished struggling, take it by the feet in one hand, the head in the other, and submerge it in the hot water, drawing it backward through the water two or three times; then remove and place on a table and pick as rapidly as possible, being careful not to bruise the skin. As soon as the bird is picked clean it may be plumped by submerging again for five or six seconds in the hot water, and then put in iced or cold water and left there until thoroughly cool.

Fig. 549.
A plucked capon.

Dry picking is preferable, because the stock thus dressed will keep better, look nicer and bring best prices. The methods of killing apply to all kinds of poultry, although the bloodless method would be a difficult task with geese or turkeys and should not be attempted with them.

In cold weather, after picking and washing feet and heads, the birds can be hung in a clean cool place and kept from freezing until shipped. In warm weather they should first be soaked in iced or very cold running spring-water to remove all animal heat. This plumps them somewhat, also, and they can be quickly washed and dried a few hours before shipping. If put in V-shaped troughs and weighted, they are given a plumper and more compact appearance than when they are hung by the shanks.

Shipping and marketing.

Each bird should be wrapped in waxed paper, and in very warm weather packed with ice. The boxes for shipping may be of various sizes, as long as they are large enough to contain a dozen or more birds, and not too large to be easily handled. Pack in two rows, with the heads towards the middle of

the box. Two or three layers can be put in a box, provided ice is packed between each two layers in hot weather. Put ice on top of the birds, and cover the boxes with burlap. The best soft roasters are often shipped in single layer cases.

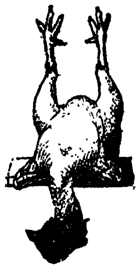

Fig. 550. Plymouth Rock hen properly dressed.

The quickest way to dispose of this product is to ship to some reliable commission house. If the stock is choice, not torn, clean picked and carefully graded, the commission-house will allow full wholesale market value, less express charges and commission. The cases when shipped should be plainly marked for whom, from whom, the number of birds, the weight and the kind. The same system of packing and marketing should be used when shipping to dealers or retailers. In addition, this class of trade should first be visited, written or telephoned to, and a bargain made as to the number and size wanted, and the prices to be paid for them. Probably the most profitable trade is to sell to the consumers themselves, when the distance is not too great, although sometimes the expresses will deliver for less than can the producer.

Feathers, when dry picked and sorted so as to keep the stiff from the soft, and the white from the colored, have a market value worth considering. All colors of soft chicken feathers bring 4½ to 10 cents per pound, and pure white bring 20 cents per pound. Duck feathers bring 33 to 42 cents per pound, goose feathers 42 to 60 cents per pound, goose quills 15 cents per pound. Long, bright-colored chicken feathers are sold for millinery purposes at about $1 per pound. The stiff turkey feathers are in great demand for feather dusters and the like. Feathers are cured in sacks of thin material exposed to the sun and air for several days. They can be sold and shipped in these original sacks.

Care of eggs.

Eggs for market will keep better from spoiling if not fertilized. Those from mated pens should be kept from warmth and heat over 60 degrees. The laying nests should be well supplied with dry sawdust or some clean absorbent. The eggs that become soiled should be wiped with a damp cloth and never submerged in water if they are to be kept more than one week. The natural color of the shell is not indicative of the quality of the contents, although the preferences of the market should be catered to, if one wishes to secure best prices. Brown-shelled eggs are usually larger than white-shelled ones, because all the larger breeds except one lay brown eggs, or those from a delicate pink to a light chocolate. The color of the yolk is controlled by feeding green foods rich in ash and protein. Eggs are porous and susceptible to taint from bad odors. Care must be taken to keep them in clean, cool places. Marking the shells in any way is not desirable. Cartons holding one dozen eggs can be purchased from paper dealers. These have specially printed covers, "One Dozen Fresh Eggs," etc., and can be used several times if desired. Cases holding fifteen or thirty dozen each, for shipping to the trade, are popular sizes. (Fig. 551.) Deliveries and shipments should be made each week; if a private trade, on the same day of each week. There are wire fillers for the cartons that display the eggs very attractively, but require more time in placing the eggs and removing them from the trays. With the straw-board fillers, each egg is in a separate compartment, and there is little danger of breakage. If one becomes cracked, the leakage is usually confined to the one compartment.

The prices fluctuate during the different seasons, highest prices being reached just previous to Thanksgiving time, and continuing until the latter part of January. The price then gradually declines until the latter part of March or first part of April, when lowest ebb is reached. By June 1 the market recovers, and the price gradually increases until November. The weather at times may affect prices. It is during these low-price periods that the surplus is bought up for cold storage or for the different methods of preservation. Those intended for cold storage must be absolutely fresh, free from dirt and packed in standard size thirty-dozen cases and the fillers must be free from mold, dirt or odors of any kind. Cold-storage plants begin operations as soon as the lowest prices are reached, about April 1, and continue until the latter part of May. During warm weather the quality of eggs deteriorates and they do not keep so well as when cooler. The market for these cold-storage goods opens in the fall and continues until Christmas.

Eggs should be gathered every day, and all broody hens removed from the house. If a nest is found in an unusual place, the eggs should be tested with a lighter before selling.

Preserving eggs.—There are several methods of preserving eggs during the period of low prices and keeping them wholesome until they will bring higher prices, but none by which they can be kept any length of time and sold as fresh-laid ones. The shells may be covered with melted paraffin or vaseline to prevent evaporation, and they will not spoil so long as they are kept cool and turned every few days. Packing in common salt and turning occasionally is another method. The contents remain sweet and wholesome, but the albumen will not beat up as it will in fresh-laid ones. The shell will lose its freshness and the eggs will not remain good long after being taken out of the preservatives, and they should be designated as preserved eggs when offered for sale.

Fig. 551. Cases for egg shipping.

The best method of preservation is as follows: One part of water-glass (sodium silicate) mixed with nine parts of boiled spring water. Put the eggs in a stoneware crock when gathered from the nests, if cool and clean, until the crock is nearly full; then pour in the water-glass solution until there is at least two inches of liquid over the top

Partridge Cochin hen

Rhode Island Red hen

White Wyandotte cock

White Rock hen

Dark Brahma hen

Light Brahma cock

Plate XIX. Prominent breeds of fowls

layer of eggs. Keep in a cool place. If carefully done, this method is reliable.

Another successful method is to slake two pounds of good lump lime, and while hot add one pound of common salt. After cooling, add ten quarts of boiled spring water and stir thoroughly several times the first day. Then let it settle, using only the clear liquid, which may be poured over the eggs after they have been placed in a stoneware crock; or the liquid can first be put in the crock and the eggs put in that, day by day, when gathered. The eggs must always be two inches below surface. More of the solution can be put in when necessary. Stoneware vessels are the most desirable ones for keeping these mixtures in.

Eggs are sometimes removed from the shells, canned and kept in cold storage or frozen, and sold to large consumers. The most wholesome method is evaporation. The egg is then reduced to powder that will keep any length of time, in any climate, and can be carried to places where poultry-keeping is out of the question, and where all eatables carried must be reduced to a minimum weight.

The market prices of all kinds of poultry products are affected by the supply and the demand. During the fall and winter, the surplus fowls and summer chickens are disposed of and there is an abundance of table poultry offered for sale. The lowest prices of the year then prevail until the bulk of the supply is gone. By April, the chickens hatched in the previous spring and summer become hard and tough in flesh and have to be sold as fowls, while those hatched during the previous fall, of either sex, if kept separate during the winter, will be soft and tender and bring roaster prices, which are the highest in the spring.

The market for fowls is uniform the year round, except for a rise of perhaps two cents per pound during the spring when all hens are laying and but few are being marketed. The annual molting period, July to November inclusive, affects the supply of eggs, as does the winter weather in any cold climate, and prices rule accordingly. When fresh killed poultry and fresh eggs are scarce and prices high, cold storage products and preserved eggs are in demand, but never does the held-over product sell at prices equal to that of recently killed poultry and fresh eggs.

The regular market reports of prices are usually reliable when applied to the average quality of poultry products, yet a superior quality of either dressed poultry or eggs will sell in advance of any current published quotations and a good market is never overstocked with this class of goods. The retail price is usually 5 cents per pound above the wholesale price for poultry, and 5 cents per dozen for eggs. Consumers who desire the best will pay a premium of 10 cents per dozen on eggs and 10 cents per pound for poultry that they know is brought to them direct from the farm. This particular trade often comes from clubs, hotels, hospitals and high-class resorts.

Literature.

For references, see page 527.

Judging Poultry. Figs. 552-554.

By *T. E. Orr.*

Prior to the year 1873, there was but little uniformity or system in the methods of judging fowls at shows. Indeed, until nearly as late a date as the one mentioned, there were few poultry shows to be judged. These were nearly all held in the autumn in connection with some agricultural fair, and were largely in New York and New England.

In February, 1873, and again in December, 1873, a few of the leading fanciers met in Buffalo, New York, and in these two meetings organized the American Poultry Association. The main purpose of this organization was to disseminate a more accurate knowledge of pure-bred fowls, and so to describe their characteristics of form and feather that a better system of breeding and judging them might result. Two meetings were held in 1874 and in 1875. By this time the real scope of the work had become manifest, and specific work was being accomplished. From the first it was realized that a definite description of both sexes of each variety, section by section, both in shape and color, was an absolute essential, and these descriptions were speedily formulated and tabulated, and then printed in a book called The Standard.

From that time to the present the work of the American Poultry Association has not greatly varied. The publication of Standards and the education of breeders and judges to uniformity, has been its chief work. Of course, in those early days there were not nearly so many varieties to describe or judge, so the work was much less comprehensive than at present. Cochins and Brahmas, Games and Hamburgs, Leghorns and Polish were the leading classes seen at shows. Some Dorkings and Spanish fowls were seen. Barred Plymouth Rocks were beginning to be heard from. Wyandottes, Langshans and many later additions to the Standard family were then unknown. Soon a multiplicity of varieties were knocking for admission to the Standard, and still it continues, although in the intervening years a hundred types have secured admission.

The Standard, with its detailed descriptions, was no sooner out than the Association deemed it its duty to put restrictions on those who should interpret the Standard by judging fowls at public exhibitions. Some members of the Association excelled as fanciers of some breeds, and some of others; so a committee was appointed to examine candidates and license judges. There are those still living who hold licenses as Specialty Judges and as General Judges. And now again, the practice of licensing judges, abandoned thirty years ago, was renewed in 1907.

Methods of judging.

There are two distinct and well-known methods of arriving at a decision in placing awards. One is by comparison; the other is by the use of the score-card. Each method depends on an accurate knowledge and a correct interpretation of the Standard. Each has its advantages and its advo-

cates. Some persons are bitterly opposed to one method, some to the other. This should not be. They really stand on the same foundation. One method, the comparison, depends on an accurate knowledge of the other, the score-card, for its elementary principles. Both methods, when accurately and intelligently applied, should reach exactly the same results when judging any class, or combination of classes, at a given show.

Comparison judging.—This is undoubtedly the older method. It has been employed in England from the inception of their now famous exhibitions. It prevailed in America exclusively until the Standard and the score-card method were promulgated by the American Poultry Association. It is the method followed today in all summer and fall shows, for until fowls have recovered from their annual molt, and until chicks have became mature in form, size and feather, the score-card, accurately applied, would show such low scores that exhibitors could not be induced to come forward with their birds.

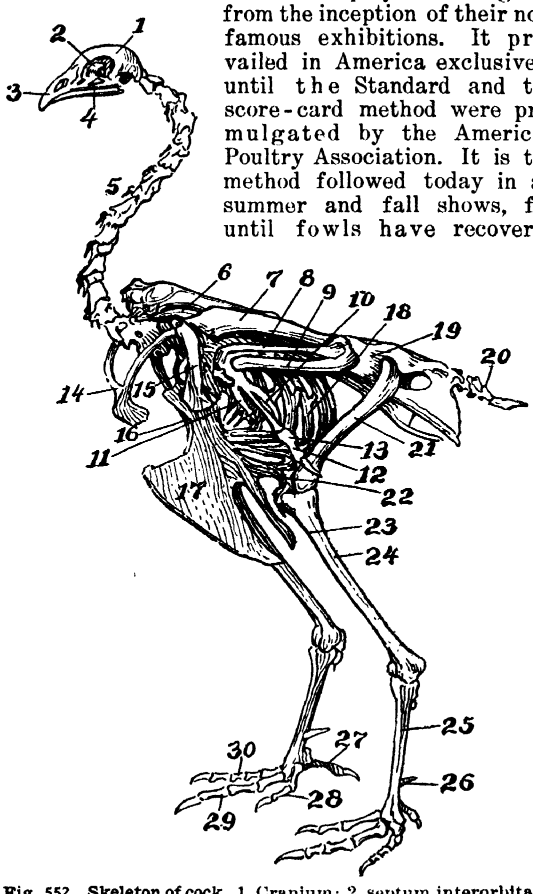

Fig. 552. Skeleton of cock. 1, Cranium; 2, septum interorbitale; 3, beak; 4, mandible; 5, cervical vertebræ; 6, scapula; 7, humerus; 8, radius; 9, ulna; 10, metacarpal bone; 11, "thumb" bone; 12, "middle" finger; 13, "third" finger (rudimentary); 14, furcula, fork bone or "wish-bone"; 15, coracoid bone; 16, sternum; 17, crest or keel of sternum; 18, ribs; 19, pelvis; 20, caudal vertebræ; 21, femur; 22, patella; 23, tibia; 24, fibula; 25, metatarsus; 26, spur; 27, hind toe with two joints; 28, inner toe with three joints; 29, middle toe with four joints; 30, outer toe with five joints. (After Ellenberger.)

Formerly all entries were made in pairs, a cock and a hen, or a cockerel and a pullet constituting a pair. This method still prevails in some fall shows or in out-of-the-way places. It cannot be discontinued too soon. A poor, or even a disqualified specimen may chance to be mated with the choicest bird of the opposite sex in the class, but the handicap is so heavy that the "best bird" wins nothing. Single entries, single and uniform cooping, and the entries so classified that all cocks of the same variety shall be adjacent to each other, likewise the hens, cockerels and pullets,—this is the only method that permits a judge to do his best work by this method. The birds being all in their places, each coop bearing a distinct coop number, then, and not until then, is the judge ready to take his first look at the competitors.

Suppose the judge finds twenty cock birds in the first class. It will take him but a minute or two to pass up and down before them and mark on his memorandum ten birds that he thinks are "not in it." But he must not pass them wholly by with this hurried glance. The exhibitors have all paid the same entry fee. Each one is entitled to attention. The judge may find, indeed often does find, that one of those cocks that he condemned so quickly, on closer examination, is found to be possessed of quality not seen at first, that puts him in the "upper ten," rather than in the list of "shut-outs." It is the safe thing for the judge to handle every bird. A group of exhibitors at the end of the aisle or up in the gallery, each anxious about his entry, may develop among themselves some jealousy if their birds are not even handled. On the other hand, if they see the judge going over and around and through each bird thoroughly, they will at least give him credit for trying to earn his money.

We cannot too strongly condemn the practice of marking the coops with the judge's private hieroglyphics. It is better for the judge to keep a private judging card on which he enters the coop number of each bird in the class; then, in his preliminary judging, he can mark off some for shape, some for color, and some for condition. He can then make his marks for shape, color and the like, on the good birds that remain. As he finally narrows the class down to a few birds, he will mark opposite each bird's number the strong or weak points of each section, until he has finally placed the winners in their correct order. He will then transfer the awards to the secretary's book, but will keep the card for his own reference and satisfaction. This method is a great protection to the judge.

After having, with care, eliminated one-half the birds in the class, the judge's hardest work is just begun. Every bird of the remaining ten may be worthy of a prize, but, at most, only five of them can receive recognition, unless it be at some large exposition, as the one at St. Louis, where seven awards were made. The judge's task continues to be a work of elimination. By going over and over the best ten birds, the judge begins to come to a conclusion as to which is the best bird in the class and which is poorest of the ten, and he makes memoranda on his card, looking to that result; then he decides which is second-best, and which is the next one to go down and out; and so he continues until the five best are so marked in their

proper order, and the poorest half of the best ten have been checked off.

Just at this point comes in the chief advantage of comparison judging over the score-card method. With a large and strong class before him, the judge can generally select for his five prize-winners fowls more uniform as to type than is generally possible by the score-card. The reason for this is hard to explain to the amateur, but every experienced score-card judge knows that when the awards are placed by the footing up of the scores, he has found that the five birds scoring highest, and thus standing closest together in the awards, are sometimes very dissimilar in style and type, and he will sometimes wish that he could rearrange the winners a little, just for the sake of uniformity. Here is the only exception the writer will admit to the general rule laid down in the beginning, that the results will be the same no matter which method is followed.

Fig. 553. Judging fowls. Examining the wings.

However carefully the judge has made his placing of the five best birds in the class, he will do well to spend a little more time and labor before he hangs up the awards. Let him remember that his awards will surely be criticised on the score-card basis; that there are many experts well posted as to Standard cuts who will not hesitate to grade the judge pretty low if he makes serious mistakes. If his first-prize bird is a perfect model in color, but not typical of his breed, has a bad comb, a bad eye and a badly carried breast or tail, he may deserve cuts aggregating six points on these four sections alone; so the judge must be careful to estimate the real value of each specimen with absolute justice. Again, a judge must not allow himself to be dazzled or overawed by the great beauty of some one section. This is the place above all others where the score-card method has the advantage of comparison; it compels deliberate, careful work, of which a written record is made and preserved.

Score-card judging.—By some persons this method is thought more closely to interpret and apply the Standard than does comparison judging. It should not be so. The comparison judge should be just as familiar with Standard descriptions, and should apply them just as exactly as does the score-card judge. The only difference is in the method, not in the result. In the one case the judge makes a record in writing of the defects of each section as he considers it; in the other, he holds these cuts and defects in mind, adding to them as he goes along, until the aggregate thereof is reached, and this constitutes the value of that bird. He may not make these cuts in actual figures for each section, carrying the number in mind until he has their sum, which, subtracted from one hundred, gives the final score of the bird; but he does what is just as hard when he carries these approximate cuts clear through, and as he passes each section institutes a comparison between the bird in hand and the one that stands next to him in position or quality.

There are those who maintain that comparison is easier either for the amateur or for the professional judge than is score-card judging. With this conclusion we cannot agree, especially if the classes be large and close. Why is the score-card less laborious? It is easier because the judge handles each bird but once, and calls off his opinion of each section to the clerk, who makes a record of it. He is then done with that bird. It is "out of sight, out of mind," so far as he is concerned, and he proceeds to pass on another bird on the one-thing-at-a-time method; whereas, by the comparison method, he may come back to the same bird a dozen times to compare one section with that of one competitor, and another section with that of another competitor, before he can finally place the best birds in their proper order.

The essential qualifications of a score-card judge may be enumerated as follows: (1) He must possess an artist's eye, that at a single glance he may take in the bird as an individual, measure his defects in type and conformation, deduct a proper valuation for the extent that he falls short of the typical bird of his breed in style, carriage and conformation, and place the sum of these defects in the column of symmetry. (2) He must have an accurate knowledge of the correct shape of head, comb, neck, wings, back, tail, and the other parts of the typical bird of this breed, also of the various cuts that the Standard prescribes for these defects, so that he can instantly place a correct valuation on them. (3) He must have an intimate acquaintance with shades and colors, not necessarily that he may give a name to the various shades of color, but have an accurate knowledge of the color demanded by the Standard for each section of each variety, so that, without bringing birds together for comparison, he may give to each section a just cut for its defects in color. (4) He must possess an intimate knowledge of the combinations of color that make up the strong points of parti-colored specimens. For example, in Barred Plymouth Rocks, Silver Wyandottes, Silver Spangled Hamburgs, Silver Sebrights, Silver Polish and Light Brahmas, it is not so much to know that these birds are a combination of black and white, as to know just how black and white come together in vari-

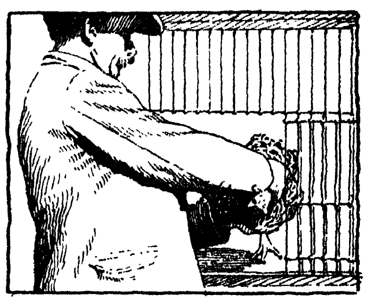

Fig. 554. Judging fowls. Removing the fowl from the cage.

ous sections, even in the same feathers. These combinations, for example in the tail coverts of the Light Brahmas, and in the flights and wing coverts of the Silver Wyandottes, are most intricate and delicate; and, in the case of the Silver Polish, the combination proper in chicks is reversed in the adult, a point for which, strange to say, our Standard does not provide.

Some shows and some judges insist on having the birds carried by attendants to a central point at which the judge and his clerk are seated, with an open exhibition coop before the judge, into which the birds are placed, one at a time. This method is slow, laborious, productive of many mistakes, and, worst of all, is utterly unfair to the birds. To go to the coop of a nervous hen, grab her by the legs and carry her, head down, to the judge, as most attendants are sure to do, and throw her into the judge's coop, and she will be so flustered and frightened that she may not assume a natural position for ten minutes. Before that time has elapsed, the judge has been compelled to pass on her and several others, and the cuts he has made on her symmetry, shape of breast and shape of tail are probably very unjust. It is far better that the judge pass quietly from coop to coop and size the birds up as to symmetry and shape, with as little disturbance as possible. While he is doing this, he can, in his own skilful way, lift each bird from its coop and call off the cuts to the clerk, thus completing each bird as he goes along.

Much can be done by the show management to facilitate the work of the judge. One of the best methods is to tack to each coop the score-card for that bird, giving in duplicate the entry-number, variety, sex, band-number and weight. As the judge reaches the coop, he tears off the card at the perforated line, leaving the duplicate heading still attached to the coop. When the score-cards have been footed and filled out, a clerk can pass to each coop, filling in, on the attached head-piece, the owner's name, the score and the award. The exhibitors are entitled to this much publicity, and visitors who pay their admission fees are entitled to this much information. Some shows follow the practice of tacking to each coop the complete score-card. This is well, provided a copy of the card has been recorded on the books of the association.

Some judges refuse to have a clerk, and not only fill out, but foot and sign their cards while standing in front of the coops. This makes "safe" work for the judge, as it enables him to see the complete score of each bird, also to locate the winners of each class before he leaves it, correcting what appear to have been errors in scoring. But the real judge never does this. He calls off the cuts for each section in their proper order, which the clerk records, and then both pass on instantly to the next specimen. The best judges do not even foot the scores or touch the score-cards until they are through with their work, and then go to the office to "sign up."

Unless the cards are copied in the records, they should not be given to exhibitors until the close of the show. Much trouble results from giving out the cards too soon.

The one thing that has caused more trouble, the past two years, than all things else combined, is the Standard directions for awarding sweepstake and special prizes. In the opinion of the writer, this is unfortunate legislation. In the first place, there should never be a sweepstake prize offered that brings different breeds or varieties into competition. All specials should name some one variety on which they are to be placed. While show committees continue to offer sweepstakes that involve different breeds or varieties, the actual scores of the judge should govern. This would soon make this class of prizes so unpopular with the fanciers of weight-clause varieties, that the practice of offering such specials would be killed. The other objectionable feature in the paragraph of the Standard above referred to is that of handicapping solid-colored specimens in favor of those that are parti-colored. Under the old Standard, this handicap was one and one-half points. It has since been reduced to only one point. The idea prevails in some circles that it is easier to breed a solid-colored variety than one that is parti-colored. As a breeder for many years of seven varieties of one breed, four of these being parti-colored and three of them being solid-colored, the writer can demonstrate that it is much easier to breed ten birds of the parti-colored varieties that will score, honestly, ninety-two points each, than to get five birds of the solid-colored varieties that will reach a like score. The judge who has had long experience, who has good sight, and who will unhesitatingly enforce the prescribed Standard cuts for creaminess and brassiness in white birds, knows that there is no bird so rare, even in our largest shows, as one that is pure white throughout. A buff bird, pure in color, free from any other shade, is scarcely less rare. A truly black bird is a trifle easier to find among the young females, but is still rarer than parti-colored birds of equally high scores.

Details of scoring. — The *symmetry* should be caught before the bird is touched. It means, not the cutting for ill-shape of the various sections, but a harmonious union of those various shape sections so as to make, as a whole, a bird typical of his own breed, and with a style and finish about him that is peculiar to the breed in hand.

The *weight* should have been taken, and recorded on the card before the judge touches it. He then makes his weight cuts in accordance with Standard rules, not forgetting that in American varieties over-weight is to be punished as well as under-weight. In non-weight varieties, judges should be more careful than they are to cut for under size. Failure to do this in past years has done much harm to Leghorns and Hamburgs.

Under *condition* is the place where the careless exhibitor should be punished, so that the painstaking man, who has kept his fowls in perfect health, who has not allowed their combs and wattles to become frost-bitten, who has manicured their shanks and toes, and has carefully washed and plumed his birds, will get his due reward.

In examining the *head*, the judge should give close attention to the length and curvature of skull and beak. An American specimen with a long and level top-piece, as in a Game, is very undesirable. The judge should also punish severely a white or pearl *eye* when the Standard calls for "red or bay," and see that the shape of the eye is typical of the breed. The *comb* stands for so much in both Mediterranean and American varieties that a most careful study of Standard illustrations and cuts is recommended. The judge should not hesitate to disqualify a comb that is unmistakably lop-sided. *Wattles* and *ear-lobes* vary in value so much with the breed that they require special attention. The judge should notice the difference in this section between Plymouth Rocks and Wyandottes and Orpingtons. In order that the large, shapely ear-lobe of the Mediterranean, with its enamel-white surface, free from folds, wrinkles or red spots, may have its just value, occurring in its perfection so seldom, cuts for the many common defects of ear-lobes should be made freely.

Most judges fail to assign full Standard value to the *neck*. It ranges from six points in some of the Bantams to ten points in the ornamental varieties and in Asiatics. In the Asiatics, we think this is rather high, but in the American breeds, three for shape and six for color is about right; and the judge should enforce it, especially on Barred Plymouth Rocks and Silver Wyandottes. Correct neck color indicates much in the breeding power of a male bird of these two varieties.

By the new Standard, the judge passes from neck to *wings*. This is the natural order. He should not be in a hurry to get away from the wings. Only four points are assigned to shape of wings, and on these four points must be made the cuts for unnaturally shaped wings, also for broken or missing feathers. We find the limit of four points scarcely enough in some cases, and often cut the full limit. The judge should study very carefully the color cuts for wings of parti-colored birds, such as Light Brahmas, Silver Wyandottes and Barred Plymouth Rocks.

The *back* is the great shape indicator of the American breeds, even more than breast or body. The writer thinks that this section should be rated just as high in Asiatics and Mediterraneans, and he predicts that the next Standard revision will witness changes in this direction. It is true that the back does not carry so much meat as the breast and body, but it is the point or place that sustains these sections, and with an ill-shaped back no breast or body can be good enough to work redemption. The judge should cut bad-shaped backs to the limit, if necessary.

The *tail* is one of the beauty points that requires careful attention. The judge must note carefully all the ranges of tail carriage, almost over his head in the case of the Japanese Bantam Cock, very high in the Langshan, and away down in the Minorca and the Game. He must study and familiarize himself with all the intermediate stations, and cut accordingly.

The shape of the *breast* of a specimen varies more with his fatness than does any other section. The judge must take this into consideration, but should not fail to punish a "turkey breast" when a "low-set keel" is called for. And here let the writer explain that fatness and fleshness mean the same. The cockerel that today weighs only four pounds, his keel as sharp as a knife-blade, his shanks seemingly "coming out of the same hole," has just as many fibers of muscle or flesh as he will have three months later when he tips the beam at eight pounds, with his deep, round breast, every muscle interlarded with delicate tissues of luscious fat, which is not greasy, but which makes each fiber round and smooth; and his shanks will then stand so far apart that he fairly waddles as he walks. The judge must learn to take all these things into consideration, and must base his cuts on breast and body on the typical bird of his breed in perfect condition.

The section, *body and fluff*, as outlined in the scale of points, has to do chiefly with the lower and rear parts of the body, the back and breast having had previous consideration. Care must be exercised in judging females to notice whether they are producing eggs or not. At such times, the egg-producing organs being very active, the abdominal section covered by the fluff is likely to be abnormally developed. One should hesitate to cut a hen heavily on shape when the evident cause is the fact that she is in daily performance of the very functions that nature intended her for.

The last item on the score-card is *legs and toes*. Here, shape and color have equal value. A very common fault with American and English varieties is that the thighs and shanks are too long. Some years ago, special rewards were offered by large western packing houses for one variety that produced a large percentage of specimens with the "legs" (first joints above the shanks) so short that when the fowl was dressed the legs would not extend beyond the rump. With the Leghorns, a common fault is that the legs and shanks are too short, making the bird low and squatty, instead of rangy and up-standing. In Cochins, these organs should be short; in Langshans, they should be long.

The scale of points says nothing about *under-color*, but as it is mentioned in almost every section containing feathers, the writer wishes to call the special attention of the young judge to it. By the English Standard and the superficial English method of applying it, under-color counts for but little. With our American Standard, calling for a thorough and searching investigation of every section, it becomes a most important factor. The judge should give it close attention and remember that if "slate" or "buff" is called for, for example, white under-color is a disqualification and must be punished severely.

Literature.

The reader should consult The American Standard of Perfection, published by The American Poultry Association, for full information for judging fowls, and for score-cards for the several families. [For further references, see page 527.]

Common Ailments of Poultry.

By *Prince T. Woods.*

Nearly all poultry diseases are preventable. Very few cases of serious illness undergo a sufficiently rapid and complete recovery to make prolonged treatment worth while. It is not good judgment to spend several dollars' worth of time and money in treating and dosing a sick bird worth less than one dollar at market prices. The practical, useful life of the average fowl seldom exceeds four years. When kept exclusively for market purposes, eggs and meat, the poultryman cannot afford to keep hens beyond their third year as egg-producers, and not many beyond their second year. The first two years of egg-production yield the best profits. This short period of useful life does not allow much time for doctoring sick fowls. Except in mild cases of sickness, the wisest, safest and most economical treatment is to kill the sick bird and burn the carcass. By so doing, one gets rid of a possible source of contagion, and minimizes the danger of spreading the trouble to the remainder of the flock.

Prevention.

The five essentials in preventing poultry diseases are:

(1) Breed only from sound, vigorous, healthy, well-matured stock. A poultryman should never use in a breeding pen a deformed specimen or one that has apparently been cured of serious illness. It is difficult to know when a fowl is really cured. Many supposedly cured individuals have the disease in chronic form. The tendency to become diseased can be transmitted to the progeny. Likewise, the tendency to resist disease may be inherited. Breeding only from perfectly healthy birds, fully grown and in their prime, insures chicks that will be able to resist disease. One cannot produce strong, healthy chickens from debilitated or unsound breeding stock. Starting with healthy breeding stock, one must keep it sound and vigorous by commonsense care and management. The eggs from healthy stock, properly incubated, should give the maximum vitality in the chicks. Such chicks, properly cared for, should possess the greatest disease-resisting power. One can breed health in poultry and fix the tendency to health, generation after generation, more easily than he can breed fancy points in size, shape and plumage.

(2) Sensible fresh-air housing is essential to keep fowls healthy. Fresh-air quarters or open-front colony houses are in the majority of cases the most satisfactory. The curtain-front, or building in which a part of the south windows are replaced by coarse unbleached muslin screens, is the next best type of building. The tightly closed house, unless run with one or more windows open night and day, and the fowls protected from drafts, is the least desirable type. An abundance of fresh air is absolutely necessary for fowls both night and day, summer and winter. It must be supplied so that there are no drafts about the roosting fowls. Artificially heated houses are always unsafe. Close or tight houses, unless thoroughly aired daily, will show frost and dampness on the walls in cold weather. Dampness invites colds and other ailments. Houses must not be over-crowded. Crowding on the roosts at night is inimical to health. The poultry-yards should be of good size and well drained. With poultry-houses of ordinary height, the minimum amount of house air space should not be less than twenty-five cubic feet per fowl. For yard room, breeding stock and layers should have a range of at least sixty-five square feet of land for each bird.

(3) Wholesome food in variety and pure water are essential to keep fowls healthy. Elaborate rations are not necessary. Fowls fed exclusively on dry grain are less liable to disease than those fed heavily on moist mashes. The average fowl requires three to five ounces of dry grain daily (according to size and appetite), in addition to meat food, green food, grit, oyster shell, charcoal, granulated bone and pure water. The staple feeding grains are corn, wheat, oats and barley. Only sound, clean grain should be used, and it should be free from dust, mustiness and mold. The drinking-water should be clean, pure and fresh. Fowls should never drink from a stream into which barnyard seepage and other filth empties. Unclean food and impure water are prolific sources of poultry disease.

(4) Prompt isolation and disposal of sick birds are important in preventing disease. Sick specimens should be removed from the remainder of the flock as soon as possible, to prevent spread of the trouble.

(5) Reasonable cleanliness in poultry quarters is necessary in preventing disease. The houses must be cleaned regularly. The runs should be plowed up and seeded down with quick-growing grain or grass twice a year. Small, hard or sandy runs should be swept frequently and the manure removed in dry weather or before heavy rains. Litter material, when used in the houses, should be clean, bright and free from any mold or mustiness. Food and water receptacles should be kept clean. Nesting material should be changed frequently. Floors of poultry-houses should be cleaned or, in case of earth floors, renewed when badly fouled.

One general rule that should be followed in every case of sickness is, seek and find the cause of the disease and remove it before treatment is attempted.

Lice.

By far the most common ailments of poultry are the parasitic diseases. There are many varieties of lice and mites affecting fowls. The presence of body lice may be readily detected by examination. Look under the wings and on the skin about the feather roots, on the abdomen, back, neck and head. All fowls are lousy unless treated. Pure, fresh, unadulterated Persian insect powder is the best remedy for body lice. It should be thoroughly dusted into the plumage and worked well down to the skin all over the body. Repeat the dusting in ten days. This, if properly done, should give several months of freedom from the pest. Lice breed on the fowl in the plumage.

Mites.

Red, black or gray mites are poultry bed-bugs. They breed in the cracks and crevices about the house or under accumulated droppings. Keep the roosting quarters clean, use freely a mixture of kerosene, one quart, and creolin, one fluid ounce, or a good liquid lice-killer, for painting roosts and dropping-boards. Do this in the morning when needed, so that roosts will be dry at night.

Scaly-leg.

This is a parasitic disease caused by a scab-mite. It is characterized by rough grayish or whitish scales and crusts, accumulating on the shanks and feet. It may spread gradually to other fowls. For treatment, apply an ointment made by mixing one teaspoonful of creolin in one cupful of melted lard. Stir the mixture until cool, when it is ready to apply. Apply daily until the scales and crusts come away and leave the shanks clean.

Simple canker or aphthæ.

The cause of simple canker is infection of scratched or abraded mucous surfaces with mold spores, other fungi or germs. It commonly appears after birds have been fighting, particularly where dusty, musty or moldy litter material is used. It is indicated by yellowish or whitish patches in the mouth or throat; these usually appear as irregular white or yellowish ulcers, surrounded by an inflamed area of mucous membrane. The treatment is to dust a little powdered boracic acid on the canker spots or sores, or apply pure creolin with a cotton swab (a bit of absorbent cotton twisted around the point of a sharp stick). A solution of fifteen grains of boracic acid in one ounce of water may be used freely as a wash.

Diphtheria.

This is a not uncommon disease of poultry, sometimes confused with canker. The cause is thought to be a specific germ, and the disease is very contagious. An apparently healthy fowl becomes suddenly ill, loses appetite, the feathers hang loosely, the bird appears dumpish, legs hot, comb hot and deep red, but later may become pale. These symptoms are accompanied by difficult breathing, cough with sharp "pip" sound, redness and inflammation of throat. Small pearl-gray or yellowish-colored patches appear on the back part of the throat, about the cleft palate. These increase rapidly in size and run together. False membrane may grow so rapidly as to cause the death of the fowl from suffocation. An attempt to remove the membrane results in bleeding. The breath is fetid. Great weakness comes on from constitutional poisoning. Paralysis may appear at any stage, and the fowl loses the use of legs or wings. Paralysis of the heart may cause death. One attack of this disease predisposes to another.

Remove the sick fowl promptly from the flock, to prevent further spread of the disease. It is seldom advisable to waste time doctoring, and it is better to kill the bird and burn the carcass. For internal treatment, give four times daily a one one-hundredth of a grain tablet of biniodid of mercury. Cleanse mouth and throat frequently with full strength peroxid of hydrogen, or with a solution of one teaspoonful of creolin in four fluid ounces (half a glass) of water. [See *Aspergillosis.*]

Aspergillosis.

This disease is sometimes confused with simple canker and diphtheria, when "cheesy" accumulations form in the mouth, throat and eyes. It is caused by parasitic fungi, which are commonly found in the dust and mold of filthy litter or dirty, damaged grain. It usually attacks only susceptible members of a flock. It sometimes appears in epidemic form and results in the speedy loss of many fowls. The fungi are inhaled with dust and may make their first attack on the lungs or internal organs, so that the presence of the disease is not suspected until well established. Sick pigeons may spread disease.

This disease is frequently mistaken for tuberculosis, as the nodules or deposits in the lungs or other organs resemble tubercles. Usually the first visible symptom is a small white nodule or "cheese" patch in the mouth at the side of the tongue or beneath it, or white patches on the back wall of the throat, the cleft palate, or at the opening of the windpipe. Frequently the fowl breathes with difficulty and expels the air from the lungs with a loud wheezing or peculiar whistling sound. Death may follow from suffocation. The course of the disease is usually prolonged, although when it appears in epidemic form it is often rapidly fatal. Mouth, throat, lungs and sometimes other internal organs are rapidly filled with "cheesy" deposits or small nodules.

For treatment, first remove the cause. Supply only clean grain, free from dust and mustiness. Remove all litter from the pens and supply only clean white sand for the birds to scratch in. Take sick specimens from the flock and kill all of those that are seriously affected. Mild cases may be placed in open sheds on some part of the farm remote from other poultry quarters. Spray the poultry buildings with a 3 per cent formaldehyde solution in water. It will be beneficial if the fowls inhale the vapor from this spray mixture. Dipping the heads in the creolin solution is often helpful. For this purpose, use one teaspoonful of pure creolin in one pint of water. Mix fresh when used and do not dip the heads of more than six fowls in the same solution. When the disease is apparently confined to the mouth and throat, mix thoroughly one grain of finely powdered permanganate of potassium with one ounce of finely powdered sugar of milk. Blow this into the mouth, throat and nostrils, directly onto the "cheesy" patches or ulcers, three or four times daily at first, then less frequently as the case improves. This remedy will be found useful in all cases of so-called canker, regardless of the precise diagnosis.

Roup.

This is a general term applied to a great variety of poultry diseases, and to diphtheria when accom-

panied by a swollen head or a discharge from the eyes and nostrils. The name "roup" is applied to all diseases accompanied by a discharge from the nostrils and eyes, including common colds and contagious catarrh.

Common colds are caused by exposure to cold, dampness, cold winds, drafts, dust, crowding in the houses, insufficient supply of fresh air, houses closed too tightly at night, or sudden weather changes. The symptoms are sneezing, watery eyes, bubbles in the corners of the eyes, glairy discharge or bubbles from nostrils, and swollen face. The treatment is to remove the cause when possible. Provide plenty of fresh air in the sleeping quarters. Usually the use of condition powders in the food or tonic in the drinking-water is all the medicinal treatment necessary to break up a simple cold. Seasoning mashes with ginger and red pepper, and feeding raw onions, often prove beneficial. If taken at the start the following remedy will usually cure: Mix twenty to thirty drops of spirits of camphor with a teaspoonful of granulated sugar. Dissolve the whole in a pint of drinking-water and allow the birds no other drink.

Contagious catarrh or true roup is thought to be caused by a specific germ. It is usually mildly contagious. In epidemic form it is very contagious and spreads rapidly.

The most characteristic symptom of roup is the peculiar, penetrating, fetid odor. Frequently the presence of the disease may not be suspected until this peculiar odor attracts attention. Handling the fowl and squeezing the nostril with the thumb shows the presence of a glairy water-white, grayish or yellowish discharge having the roup smell. The discharge at first is usually frothy and watery; later, it becomes grayish, then thick and yellow. It may accumulate in considerable quantities beneath the eyelids. It dries on the beak, also on the feathers of the body, particularly about the wings, where the fowl has wiped off discharges. The legs are hot, the comb and the wattles usually hot and deep dark red. The disease may spread through the sick birds' contaminating the food and the drinking-water. It usually develops in two to seven days after infection. Many cases are mild, but in all the roup smell is present. It frequently appears in chronic form, running a course of weeks, months, or years, the specimen being always a source of infection for other birds. Neglected common colds prepare the way for roup. After the fowls are apparently cured, the roup smell will cling to the plumage, and even to the poultry-house after disinfection.

Do not waste time and money on a seriously sick specimen; kill and burn it. Remove all suspected cases to an open-front shed, remote from other poultry buildings. Use the creolin dip recommended in aspergillosis. Thoroughly disinfect poultry quarters as soon as sick or suspected birds are removed. Make the fowl inhale creolin vapor by spraying over it (in a sprayer throwing a fine mist) a solution of one teaspoonful of creolin in a pint of water. Cleansing the fowl's head, eyes, nostrils, mouth and throat with creolin disinfectant, followed by keeping the bird in strictly open-front fresh-air quarters, will do more to cure this disease than dosing. When accompanied by ulceration of the mucous membrane in the mouth or throat, use permanganate of potassium and milk-sugar powder, as recommended in the treatment of aspergillosis. Feed stimulating and easily digested food.

Diarrhea.

Diarrhea, which is often a symptom of many diseases, is a trouble commonly noticed by the poultry-keeper. It is usually the result of indigestion, eating spoiled food, or too much meat food. It is indicated by looseness of the bowels with yellowish, greenish, dark or watery discharges. The treatment is to find and remove the cause, put the affected bird on a diet of dry grain, withhold meat food, and feed charcoal freely. Scalded milk, thickened with well-boiled flour and seasoned with ginger, may be given freely, and is usually all the treatment necessary in simple diarrhea.

Contagious diarrhea.

Under this general head, we include all contagious or infectious diseases resulting in inflammation of the mucous surface of the intestines. These diseases are usually the result of infection with one of several varieties of bacteria or germs which multiply rapidly, resulting in irritation and inflammation of the mucous lining of the intestines, with invasion of the liver, kidneys and other internal organs. The infection usually takes place through contaminated food or drinking-water. It commonly occurs when fowls are kept in dirty, filthy runs and obliged to drink water polluted with their own droppings, or with the excrement of pigeons and water-fowl, or with seepage from the barnyard.

The symptoms usually develop rapidly. The bird is thirsty, has little appetite, is dumpish and not disposed to move about. The discharge from the bowels is loose and watery, and may be a dark or bluish green, sometimes streaked with blood. The affected bird stands with the neck drawn back on the body, the tail drooped and the feathers held loose. The comb and the wattles are dark red or purplish and the legs hot. The disease may run a course of five days to five weeks. In prolonged cases, there is usually great loss of flesh. Some cases recover spontaneously, but in others death occurs, usually from exhaustion.

For treatment, first of all remove the cause. Isolate the sick birds; use disinfectants freely; disinfect and remove the excrement; supply only wholesome, easily digested, stimulating food and pure water in clean receptacles. Calomel given in one one-hundredth of a grain doses three times a day frequently proves beneficial. For obstinate cases or cases in which the excrement is blood-streaked, dissolve twelve tablets of mercury bichlorid, one one-thousandth of a grain drug strength each, in one quart of drinking-water and allow the birds no other drink; or for individual treatment, give one one-thousandth of a grain tablet of mercury bichlorid three times daily. Give remedy less often as soon as case shows improvement.

Fowl cholera.

Fowl cholera is caused by a specific germ. It is very contagious and may be transmitted by contact, inoculation or through the food and drinking-water. It usually makes its appearance in three days to three weeks after infection. The earliest symptom is a yellowish discoloration of that part of the droppings normally white, which gradually becomes a deeper yellow, frequently turning greenish or deep bluish green. The fowl is inclined to separate itself from the flock, becomes unsteady on its legs, and walks with a staggering gait; the feathers are rumpled and stand out from the body; the wings droop, the head is drawn down with an apparent shortening of the neck, tail drooped or horizontal; the comb and the wattles become pale, and the legs hot; the appetite vanishes and the bird refuses to eat; the crop remains hard and full of food, due to partial paralysis. Death may occur at any time and is usually ushered in by convulsions and sharp cries.

Treatment is seldom satisfactory. Sick birds and all suspected cases during a cholera epidemic should be promptly removed from the flock. Disinfectants should be used freely about poultry-houses and yards, and every precaution taken to avoid further spread. The remedy most likely to prove effective is mercury bichlorid in tablets of one one-thousandth of a grain drug strength each, as recommended under contagious diarrhea.

Limberneck.

This is another common name applied to all ailments in which the common symptom of paralysis or loss of the use of the neck muscles occurs, so that the head and neck hang limp, or the head hangs with the neck arched from the body, or the neck is twisted back on the body. It is due to nerve disturbance, usually dependent on intestinal irritation. The most frequent causes are poisoning from eating putrid meat, paint skins, commercial fertilizers, spray mixtures and the like, or irritation caused by the presence of intestinal parasites. In cases of suspected poisoning, remove the bird to a small, clean, dry coop in warm, well-aired quarters. Make it swallow quantities of flaxseed gruel, white of egg and warm milk seasoned lightly with ginger. Examine the premises carefully to remove the cause if possible.

Worms.

Fowls commonly have intestinal worms. These are spread rapidly through the flock by the food and the water becoming contaminated with the droppings of affected birds. Worms may be noticed in the droppings. In other cases, one may get limberneck or wry-neck symptoms that cannot be attributed to poisoning. The best treatment is to give the bird, after it has been fasting twelve hours, at one dose, a mixture of two teaspoonfuls of oil of turpentine and one tablespoonful of sweet or olive oil. This should be introduced directly into the crop through a rubber tube passed down the throat. The dose may be repeated in twelve to twenty-four hours if necessary. Disinfect all droppings with a strong creolin solution, not less than five fluid ounces of creolin to a gallon of water.

Gapes.

Gapes is a disease of small chickens caused by a parasitic worm common in some sections of the country. The worms attach themselves to the mucous lining of the windpipe. Fowls are sometimes affected and may spread the contagion. Frequently clean and disinfect coops and runs occupied by young chicks. Prepare the ground for the occupancy of the chicks by a thorough top-dressing with slaked lime worked well into the soil. Plant to some quick-growing green stuff. Confine the chicks until well grown. Remove frequently to new runs prepared in the same way. Disinfect old ground with a strong creolin solution, or a 3 per cent sulfuric acid solution, as soon as the chicks leave it. Gape-worms may be removed from the windpipe of the chicks by means of a loop of horse hair or a wire gape-worm extractor. The extractor should be dipped in a weak solution of creolin. Shake off all excess of the solution before introducing the extractor into the windpipe. The chick's neck should be stretched and the mouth held open, the extractor introduced into the windpipe through the mouth, and removed with a twisting motion. This will usually bring out the greater part of the worms and the remainder will be killed by contact with the solution adhering to the extractor. The extractor with the worms attached should be dipped immediately into a strong disinfectant.

Pip.

Pip is a common ailment, and the name is applied by poultrymen to inflammation of the mouth usually characterized by drying of the mucous membrane, resulting in a hard, horny scale forming on the end of the tongue. Frequently this occurs as a symptom of some other trouble, as a heavy cold or bronchitis. In such cases the disease and not the symptom should be treated. Do not attempt to remove the "pip" or horny scale by force, but wait until it comes away easily. Glycerine and water equal parts may be applied freely, and this is usually all the treatment needed; or the attendant may wash out the mouth frequently with a solution of fifteen grains of boracic acid in one ounce of water. Either remedy may be used freely without danger.

Bronchitis.

Bronchitis is an inflammation of the mucous membrane of the larger air-passages. It is usually the result of exposure to bleak, wintry winds, cold, wet storms, sleeping in drafts in crowded quarters, too close confinement in tight houses with an insufficient supply of fresh air, or inhaling irritating dust. The most noticeable symptoms are rattling in the throat and difficult noisy breathing. Place the fowl in comfortable fresh-air quarters, where it will not be exposed to drafts. Feed nourishing, stimulating food. In the drinking-water, use twelve tablets of arsenite of antimony, one one-

thousandth of a grain drug strength each, to each pint of water, and allow the bird no other drink.

Literature.

Wood, The Poultryman's Formulary; same, Facts About White Diarrhea; same, Insects Affecting Poultry; Salmon, Diseases of Poultry, George E. Howard & Co., Washington, D. C. [See also, references on page 527.]

Poultry-House Construction. Figs. 555–570.

By *James E. Rice.*

The modern poultry-house is a compromise between two extremes in poultry-house construction: between the open-shed shelter on the one hand, which was too open, and the large, double-boarded, tight house, which was too close. In the former, fowls suffered from the cold; in the latter, they

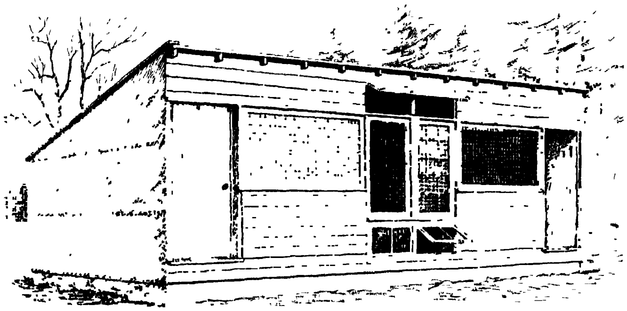

Fig. 555. A hen-house complete.

suffered from lack of fresh air. Of the two, the first was to be preferred. The modern poultry-house is the composite of the successes of centuries and the result of the elimination of many mistakes. It has been gradually worked out through the expensive, practical experiences of poultrymen, rather than by the discoveries of scientific truths regarding poultry architecture. Poultrymen built houses of various types and gradually discovered which gave them the best results. The scientist now endeavors to formulate theories to explain these results.

The successful poultry-house must be, first of all, cheerful, healthful, comfortable, convenient, inexpensive and durable. In order to meet these requirements, it must be built to meet the conditions of the climate. Manifestly, a poultry-house that is best adapted to meet the requirements of the long, cold winters of the North would not be best suited to meet the requirements of the long, hot season of the South. The principles of construction, however, are of general application and may be modified to suit conditions.

The size of the flock in its relation to construction.

The modern tendency in poultry-plant management is toward larger flocks and therefore toward larger houses. This is in conformity with the effort to save labor. The great handicap to extensive poultry-keeping in the past has been the limitation of man's ability to handle large numbers of fowls profitably. One of the efforts to overcome this handicap is to increase the number of fowls kept in a pen. It may be laid down as a principle of general application that dividing the flock multiplies the labor, and conversely, multiplying the flock divides the labor. It is also true that increasing the number of fowls in a flock multiplies the danger and increases the responsibilities. Furthermore, it seems to have been proved that the smaller the flock, the larger the production per fowl, other things being equal. Just what size of flock will be likely to yield the maximum production with the minimum labor and risk, is not yet proved. Twenty years ago, flocks of fifteen to twenty-five fowls in a pen were common; today they are rare. Now flocks of thirty to fifty are common, and on a few of the large and apparently successful poultry-farms, fowls are being kept in flocks of sixty to one hundred, and in rare instances, two hundred to three hundred or more in a single pen.

Amount of space per fowl.

The unit for estimating the capacity of poultry-houses is the square feet of floor space allowed per hen. In this respect, also, the effort to save labor has modified the practice. Formerly it was thought necessary to allow each fowl eight to ten square feet of floor space; now, four to five square feet per hen is generally thought to be sufficient. A few poultrymen allow as little as two and one-half to three square feet of floor space per fowl. The space that must be allowed for the maximum capacity of a pen, with the minimum of labor and risk, will depend on several important considerations:

(1) The locality and the season of the year. If the fowls are to be allowed to run out on the range a large part of the year, the danger from congestion in the houses will be far less than in a locality where the season of close confinement in the houses is longer. Manifestly, during the summer season, when hens are largely out-of-doors, more fowls can be kept in a pen than during the winter season when they are confined.

(2) The larger breeds require more floor space than do the smaller breeds, but not so much per pound live weight, because of the fact that the lighter breeds are more active and impatient under restraint. For the more active breeds, a good

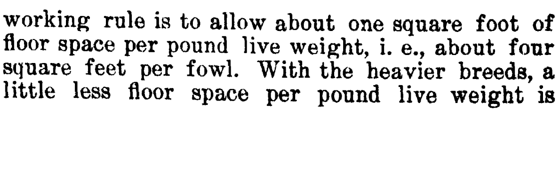

Fig. 556. Location of poultry-houses with reference to air-drainage.

working rule is to allow about one square foot of floor space per pound live weight, i. e., about four square feet per fowl. With the heavier breeds, a little less floor space per pound live weight is

needed; in other words, six-pound fowls should be allowed about five square feet each.

(3) Fowls kept in large flocks require less floor space per hen than do those kept in small flocks.

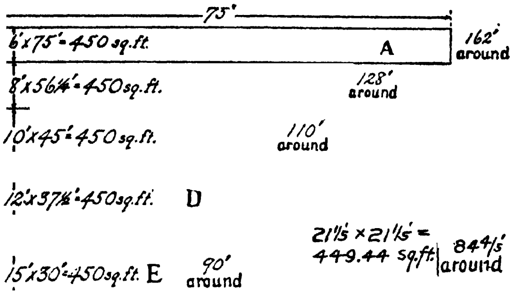

Fig. 557. Showing relation of shape of house to economy of construction. Square houses economize lumber and labor of construction.

This is due to the fact that in large flocks each hen has greater freedom of action, i. e., has more space for exercise.

Location of the poultry-house.

The location of a poultry-house has much to do with its value. The following factors must be considered:

(1) It should face the south if possible, in order to get the largest benefit from the sun.

(2) It should be protected from the prevailing winds by being placed in the lee of a hill, of trees, or of buildings.

(3) It should stand on well-drained soil in order to insure dryness, warmth, cleanliness and healthfulness.

(4) It should be placed on productive soil in order to insure good sod pasturage and healthful growth of trees for shade.

(5) It should be on land high enough to insure good air-drainage. (Fig. 556.) Cold air settles in low pockets. Such locations are frequently colder than the higher and more exposed situations.

Shape of the house.

The nearer square a pen is, the less will be the cost for material and labor of construction as compared with a pen that is longer and narrower and contains the same number of square feet of floor space. (Fig. 557). It is 162 feet around a house 6 x 75 feet, and only 84.8 feet around a house 21.2 x 21.2 feet,—a difference of 77.2 feet. Each house contains the same number of square feet of floor space, and therefore each would accommodate the same number of fowls. Pens 15, 18 or 20 feet square are the more desirable widths, depending somewhat on the kind of roof that it is desired to build.

Foundation.

Heavy, expensive foundations are unnecessary for hen-houses. A well-made concrete wall, four to six inches on top and eight to ten inches on the bottom, straight edge on the outside, the top six inches above ground and the bottom eighteen inches below ground, is all that is required. Such a foundation should keep out surface water, is practically rat-proof, and if the land is naturally or artificially well drained, should not be affected by freezing. When sand and gravel cost not to exceed $1.25 per cubic yard, cement 55 cents per bushel, and labor $1.50 for ten hours, the wall should be built for 17 cents a square foot. In Fig. 558, at A is shown a combination of stone and grout foundation combined with cement floor. Both foundation and floor are built complete before the framework of the house is begun. The stone under the foundation and floor provides drainage and lessens the danger from heaving. At B is shown a stone foundation and cement floor. The loose stone wall is cheaper but not so tight or serviceable. Note the method of cementing against the sill in order to prevent the entrance of air between the sill and foundation. At C is indicated a beveled outside edge of the foundation, which is less desirable than the foundation shown at A, where the outside edge is vertical and the siding overlaps the sill and cement floor. At D is illustrated a type of stone wall laid in mortar and "pointed up," in order to insure neatness and tightness. This ordinarily is too expensive because of the high price of labor.

Height of the poultry-house.

Poultry-houses must be built much higher than would be necessary for the hens, in order that they

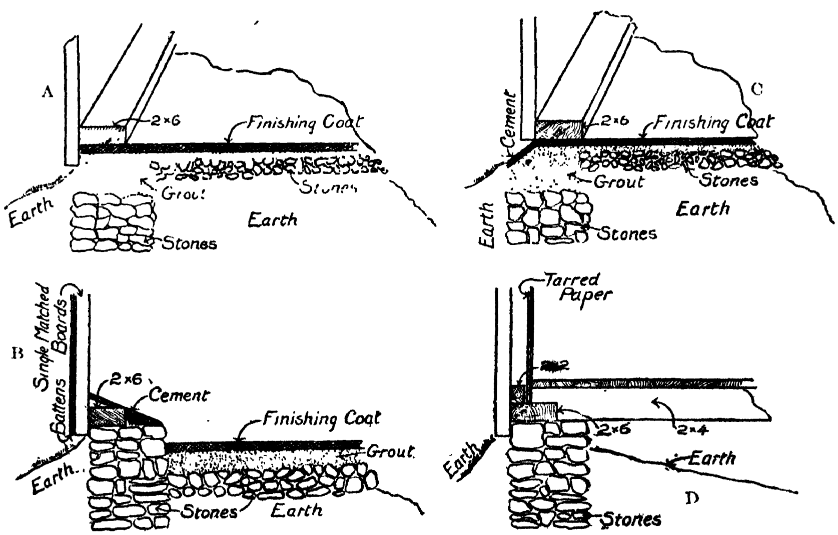

Fig. 558. Different styles of foundations.

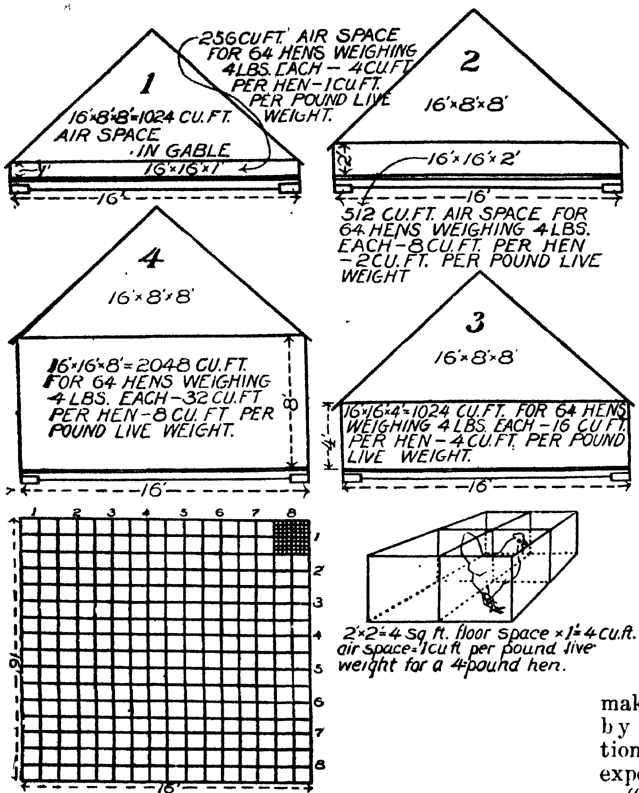

Fig. 559. Amount of air space in houses of various heights, and the square feet of floor space allowed for each pound of live weight.

may be convenient for the attendant to work inside. The rule of one cubic foot of air space to one pound of live weight, which is used in building stables, would make the hen-house only one foot high. This is assuming that we are to allow one square foot of floor space to each pound of live weight. Such a condition is illustrated in Fig. 559, which shows the allotment of the floor space in a pen 16 feet square to 64 hens, weighing 4 pounds each. Numbers 1, 2, 3 and 4 show the height of the pen, not including the roof space, when 1, 2, 4 and 8 cubic feet of air space, respectively, are allowed per hen. The roof space alone provides 4 cubic feet of air space for each pound live weight for 64 hens weighing 4 pounds each. It will be seen that with the above allowance, a poultry-house with a one-half pitch gable roof and 6 feet high at the eaves, would allow 10 cubic feet of air space for each pound of live weight, which is about ten times as much as would be allowed per pound of live weight in building a stable; hence, the rule which requires that a poultry-house should be built as low as possible without inconvenience to the person working inside.

Kinds of walls. (Fig. 560.)

The walls should be so constructed that they will prevent drafts, retain the heat, and prevent condensation of moisture. Several possible types are as follows:

(A) Single, unmatched boarding. This is too open, too cold, and too drafty.

(B) Same as (A), with cracks covered with batten. It is not tight enough. Battens are expensive.

(C) Matched (tongued and grooved) boards. This is sufficiently tight and warm for most sections of the country. It is the least expensive construction considering its effectiveness.

(D) Same as (C), with heavy building-paper either on the inside or outside. Tighter and warmer than (C) and desirable on exposed locations. Outside papering is preferable to inside.

(E) Same as (D), with inside lining of matched boards with dead-air space. It is too expensive and unnecessary. The dead-air space becomes a cold-air chamber, which is likely to cause moisture to condense on the inner wall if the house is tight.

(F) Same as (E), except that the dead-air space is stuffed with insulating material, which makes it less affected by weather conditions, but it is too expensive.

(G) Same as (F), except that the ceiling is unmatched and permits the free entrance of air. It prevents the formation of a cold jacket, because it warms during the day, and the wall and straw serve the purpose of preventing the warm air of the room coming in contact with the cold outside boarding and having its heat taken away. It is cheaper than (F), and more to be desired, but will form a harboring place for mites if roosting arrangements are placed against it during the summer season. (H) This is double-boarded and double-papered, with dead-air space; or the same material may be built solidly together. Both are

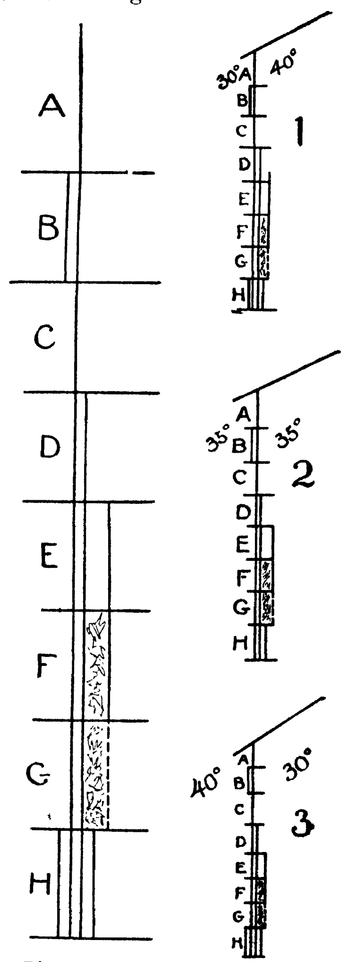

Fig. 560. Eight types of walls used in poultry-houses.

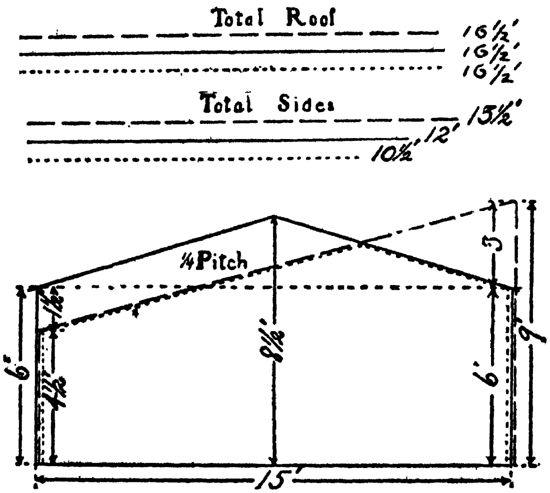

Fig. 561. The shape of the roof influences the cost The combination-roof type of house takes less material than the gable-roof type, and the latter takes less than the shed roof.

too expensive, and therefore are undesirable. The solid construction is tight, but cold.

Numbers 1, 2 and 3 in Fig. 560, show the comparative temperatures outside and inside a house at different times of the day, and the effect that each type of wall will have on the warmth and dryness of the house under varying conditions. When a house is tight and insulated, and the air is not allowed to change freely, it will be warmer during the cold nights inside than it is outside the house. When the sunshine, the following day, warms the air outside, frequently it is colder inside than it is outside the house. When warm air enters it picks up the moisture. The moisture-laden air comes in contact with the cold walls, which condense the moisture, and the house is said to sweat. If the walls are sufficiently cold, the moisture freezes and the walls are covered with frost.

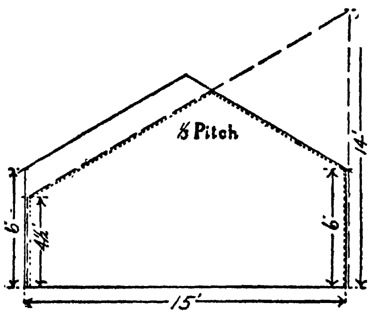

Fig. 562. The shed roof requires the most lumber.

In order to secure reasonable warmth and dryness in a hen-house, the walls should be tight on all sides, including roof and floor, except the south, which may be comparatively loose. This provides a quiet interchange of air without draft.

Roof of the poultry-house.

The style of roof influences to a large extent the cost and efficiency of a poultry-house. Fig. 561 shows the three most common types of roofs,—the shed, the gable and the combination shed and gable. If the pitch of all of these roofs is alike, there is no difference in the amount of material required to build them. There is considerable difference, however, in the amount of material required to build the house when these three kinds of roof are compared. The difference is due to the amount of material required to build the sides in each type. It will be readily seen in Fig. 561 that the house with the combination roof requires less lumber than the gable-roof house, and that the latter requires less than the shed roof. The gable is one and one-half feet higher in the rear, and the shed roof three feet higher in front—a difference of one and one-half feet in favor of the gable roof. The steeper the pitch of the roof, the greater is the difference in favor of the gable roof, and against the shed-roof type. (Fig. 562.) If all three types are built with the same pitch, and the same amount of material in the roof and sides, and the front in all three types is built high enough to permit the top of the window to be placed five feet high, the three types of houses will appear as in Fig. 563. In the shed-roof house, the ceiling is too low to be practicable, but the windows can be placed highest. In the gable-roof type the windows

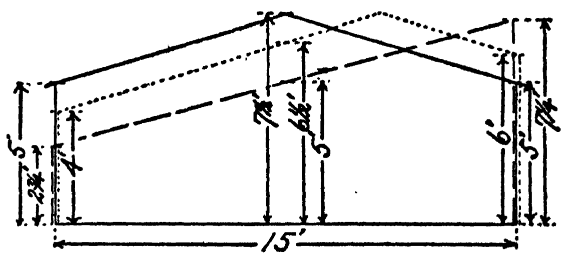

Fig. 563. Each of these three houses requires the same amount of material, and the pitch of the roof is the same.

must be placed too low. The combination roof furnishes the best combination of head room and height of window, with the least amount of building materials, same floor space, and least cubic feet of air space.

In Fig. 564 are shown six styles of roof. The monitor (1) and half monitor (4) are types adaptable to houses twenty feet wide or wider. They provide for light in the back part of the house and save expense for material, permit a steeper pitch,

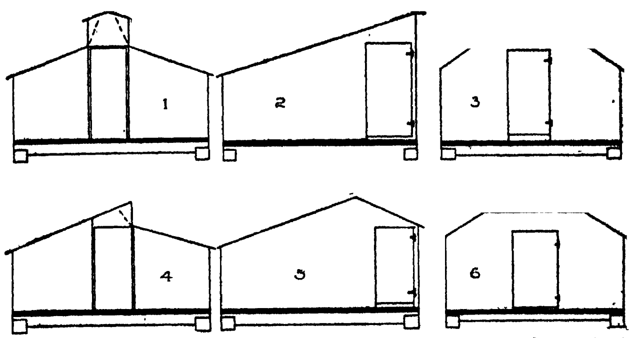

Fig. 564. Roof types. 1, monitor; 2, shed roof; 3, gable roof; 4, one-half monitor; 5, combination shed and gable; 6, hip roof.

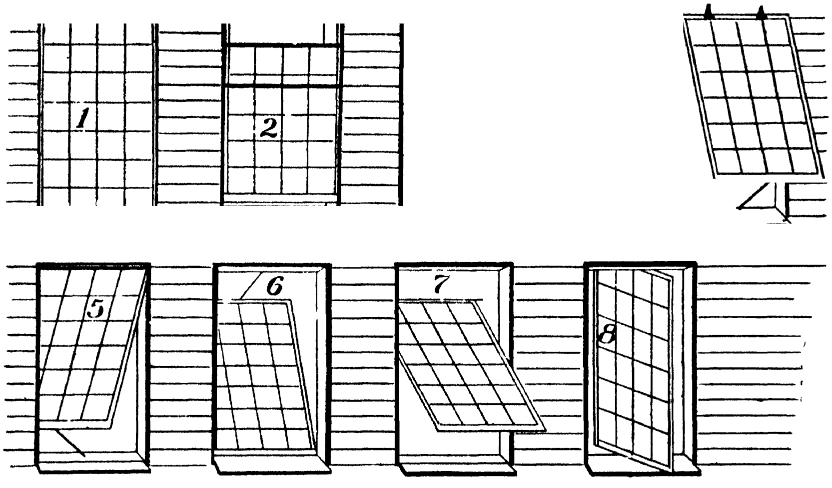

Fig. 565. Methods of hanging windows.

avoid the weakness of long spans and reduce the air spaces as compared to the very wide shed-roof house. For houses up to eighteen feet wide, the shed roof is to be preferred because of its simple construction. It throws all rain water to the rear, has the highest vertical front to permit high windows and to furnish shelter to the yard in front. It is easy to keep cool in summer because it allows the hot air an easy escape through the high front. The paper roof lasts longer if it slopes to the north. The gable-roof type is generally considered to be more attractive, but provides too much air space and is too expensive if the sides are built high enough to permit the windows to be placed so as to light the entire house.

Windows.

In Fig. 565 are shown eight types of windows and methods of hanging them. No. 1 is hinged on the side, which may generally be considered the most desirable, all things considered. It can be quickly swung against the wall, out of the way, and can be opened little or much to provide ventilation without permitting the wind to blow directly into the house. No. 2 is a double-sash window which slides up and down. It is difficult to remove in the summer season and costs more to buy and install than a single sash of the same size. No. 3 slides to one side. It is difficult to move because of weight, especially in cold, stormy weather, when ice may freeze it fast. No. 4 swings out from the top and makes it necessary to have the wire on the inside; it is difficult to move, likely to be broken by the wind, and makes the pens too hot in summer by reflection of the sun's rays. No. 5 is hinged at the top and swings inward. It must be raised out of the way when opened, and, because of weight, is likely to fall and break. No. 6 is in the way when opened and in that position permits the fowls to roost on it; it cannot be easily removed. No. 7 makes it impossible to have wire on either the outside or the inside, and is not strong and durable. No. 8 has the same objections as No. 7.

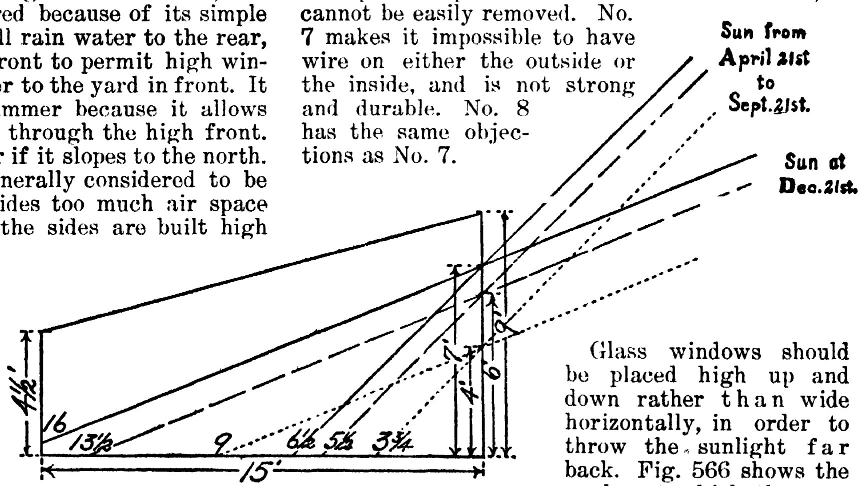

Fig. 566. The angles at which the sun's rays enter the house through windows at different heights.

Glass windows should be placed high up and down rather than wide horizontally, in order to throw the sunlight far back. Fig. 566 shows the angles at which the sunlight enters a poultry-house at different times of the year, when the tops of the windows are placed four feet, six feet and seven feet, respectively. It will be seen that in order to have the direct sunshine reach the back of a house fifteen feet wide, in December when the sun is the lowest and sunshine is most to be desired, it is necessary to have the top of the window seven feet high. By having a long, narrow ribbon of light enter the house through a long, high window, placed vertically, the sun, passing from east to west, sweeps the entire floor space, drying the floor, killing disease,

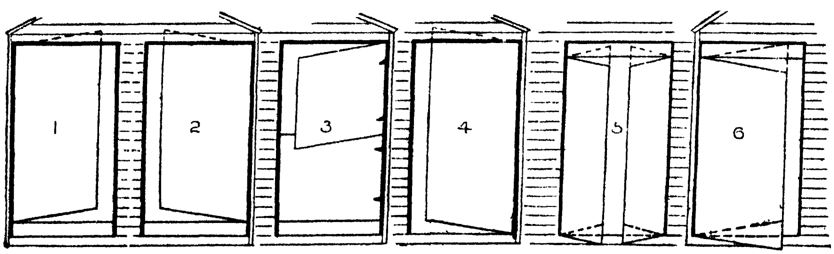

Fig. 567. Types of doors and methods of hanging them.

warming the room and giving good cheer. There should be about one square foot of glass surface provided for each twenty square feet of floor space, and about the same amount of cloth window area. If only cloth or only glass windows are to be used, there should be about one square foot of window opening to each ten square feet of floor space. Windows in the roof are undesirable because more easily broken, and are likely to leak. Windows placed on the east and we t ends of a house are desirable, provided they do not permit drafts through the house.

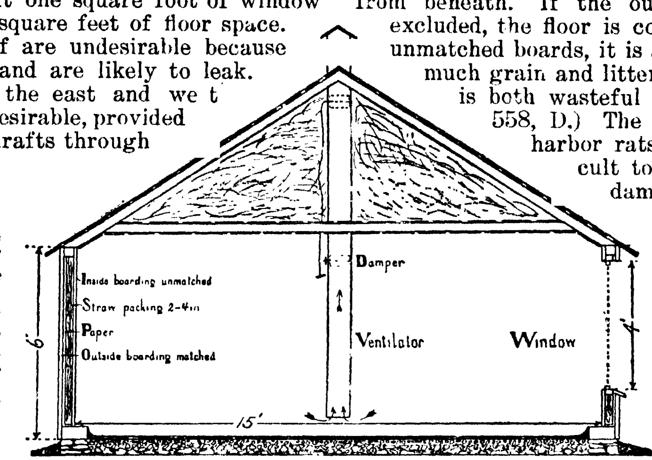

Fig. 568. Cross-section of house. Note wall construction, ventilating device, and gable stuffed with straw.

Doors.

In Fig. 567 are shown six types of doors and methods of hanging them. No. 1 shows a door that is hung to swing in toward the middle of the room. It is objectionable because it frightens the hens and is less convenient as it must be opened so wide. No. 2 opens against the side wall away from the middle of the room, and does away with the objections to No. 1. Both of these doors have threshholds raised six inches above the floor, which prevent the litter from interfering with the action of the door and, when the door is open, prevent the fowls scratching out the litter. No. 3 is a "Dutch" door, i. e., it is in two parts. The upper door may be opened during winter weather, thus serving the purpose of an open window, and the lower part may remain shut to prevent the wind from blowing on the fowls. No. 4 does not have the raised threshhold. No. 5 is a double door, swinging both ways on double-acting hinges. This is a desirable form for large houses, where a trolley and truck are used, but is unhandy for general use. No. 6 is a single door swinging from the side with heavy, double-acting hinges, and is greatly to be desired because it permits rapid passage through the house without the necessity of stopping to latch and unlatch doors. Doors should be not less than two feet, six inches wide and six feet, six inches high, in order to permit a person topass through easily with a basket in each hand and to avoid bumping the head.

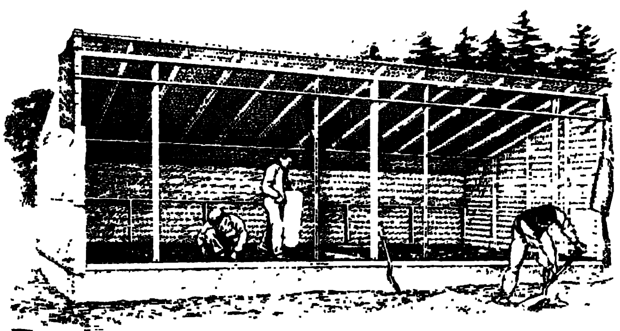

Fig. 569. Interior of hen-house in process of construction. Finished structure shown in Fig. 555.

Floors. (Fig. 558.)

The floor of the poultry-house should be so built as to insure dryness, warmth, rat-proofness, ease of cleaning and durability, with reasonable cost. A properly constructed cement floor accomplishes all the requirements better than either a board or a soil floor. A board floor lacks durability if it is near the ground and if the outside air is excluded from beneath. If the outside air is not thus excluded, the floor is cold, and if it is made of unmatched boards, it is also drafty and permits much grain and litter to fall through, which is both wasteful and unsanitary. (Fig. 558, D.) The board and earth floors harbor rats, and the latter is difficult to clean and likely to be damp. Each of these floors will be cold unless it is well carpeted with a litter of straw.

A properly constructed cement floor must be well underdrained, with three to six inches of fine stone or coarse gravel, on which two or three inches of grout is laid, over which should be placed about one inch of cement. The grout should be mixed one part portland cement to three parts clean, sharp sand and five parts coarse gravel or fine stone. (Fig. 558, ABC.) The one-inch coat should consist of one part portland cement to three parts clean, sharp sand, well mixed dry and then thoroughly mixed with water and applied before the grout is hard, so that they will set together. Cement floors, if possible, should be made in summer or early fall, so that they will have time to harden and dry before the houses are occupied.

Ventilation.

However desirable the elaborate modern systems of ventilation may be for larger buildings, they are not to be recommended for hen-houses. The chief reason why they have proved unsatisfactory in poultry-buildings is because of the comparatively small amount of heat generated by the fowls' bodies in proportion to the large amount of air space. This makes a draft in the ventilator less certain because of a lack of difference in temperature between the outside and the inside air. Fig. 568 shows a common, undesirable type of ventilator shaft. This form is better, however, than the ventilator shaft that opens near the roof, because it takes the air from near the floor and does not allow the warm air to escape so rapidly, nor is it so likely

to permit counter currents to form, by which the cold air pours down on the fowls.

The simplest, most effective, least expensive and most easily operated system of securing a quiet change of air in a poultry-house is by means of a loose-mesh cloth window. When properly installed, this provides for a moderate change of air without draft. The amount and kind of cloth that should be used will depend on the location and the nature of the house. The tighter the house, the larger the window area and the looser the mesh of the cloth may be; and conversely, the more loosely the house is constructed, the smaller the cloth opening and the closer the mesh of the cloth must be. A small opening on the back, the ends, or in the roof or floor of a house, will cause drafts of air to pass through the cloth, which otherwise would permit only a slow diffusion. In a very tightly constructed house, cheese-cloth will prove more satisfactory than heavy muslin. A poultry-house having a cloth window may become damp if there is not sufficient change of air, which frequently is the case when too heavy muslin or too small area of cloth is used in a tight-walled house. Oiled cloth should never be used. It shuts out both air and sunlight and defeats the whole purpose of the cloth window. The cloth windows should hinge from the top and be so hung that they may be raised, lowered and removed easily.

A poultry-house should be kept as cool as possible in the summer by hanging the cloth window frames from the top on the outside of the windows. They thus serve as an awning and make the house much cooler during the hot season. An opening in the front, near the peak of the shed-roof house (Fig. 555), covered by a wooden door hinged by the top to swing outward, prevents the hot air from pocketing in the highest parts of the roof and makes the house much cooler. A single opening in the rear of the house, under the eaves, if placed so as to prevent draft on the fowls, is a desirable feature, keeping the house cool during summer. The method of double boarding behind and above the perches (Fig. 569) makes it possible to have a free passage of air through the house by means of the back window without drafts on the fowls.

Interior arrangements.

The interior arrangement should be portable, simple, convenient, and should not occupy floor space. Fig. 570 shows four methods of placing the roosting and nesting arrangements. In "A," the perches and nests hang from the rafters away from the side wall, making it easy to fight the mites. The droppings platform must be made rigid or it will be difficult to clean. Type "B" provides for a rigid droppings platform and removable perches. Type "C" is not to be recommended because it lacks rigidity. The nests should be close up under the platform instead of on the level of the floor, which requires the person gathering the eggs to bend over. Type "D" is perhaps the most desirable of the four devices shown. The nests are placed directly under the droppings platform, where they are least in the way, most accessible, least expensive to construct, and seclusive, permitting the fowls to hide their nests. The perches are built together in a rack, are not hinged, and are removed together. The droppings platform rests on cleats, and, like the nesting compartment, is removable. Nests should be at least ten to twelve inches square and six to eight inches deep. One nest should be allowed to five fowls. About six inches of perch room is required for small fowls and eight inches for larger breeds. Every pen should be provided with a dust bath and broody coop, water pan, grit- and feed-hoppers and a grain-supply can. The feed- and grit-hoppers should be rat proof, force-feeding and non-wasting. The broody coop is best provided by partitioning off a part of the perch platform and providing a false floor to keep the fowls dry and clean. The dust bath should be placed close to the glass window, where it will be warmest and dryest. It should be covered to prevent the dust entering the room. A pit sunk in the cement floor, near a low window (Fig. 555), makes a desirable dust wallow. Water pans should hold more than enough to last the flock twenty-four hours, should be easily cleaned, filled and emptied. They should have flaring sides to make the removal of ice easy, and should be made of material that will not rust or break easily.

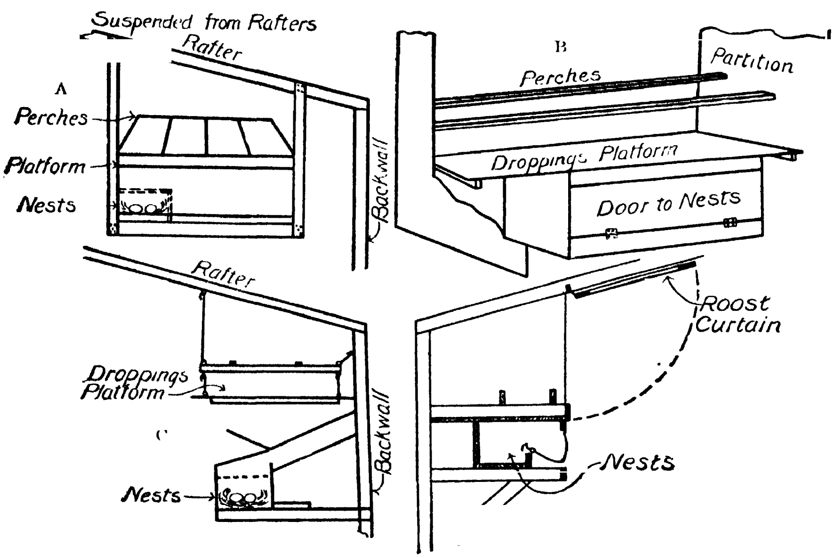

Fig. 570. Nests and roosting arrangements.

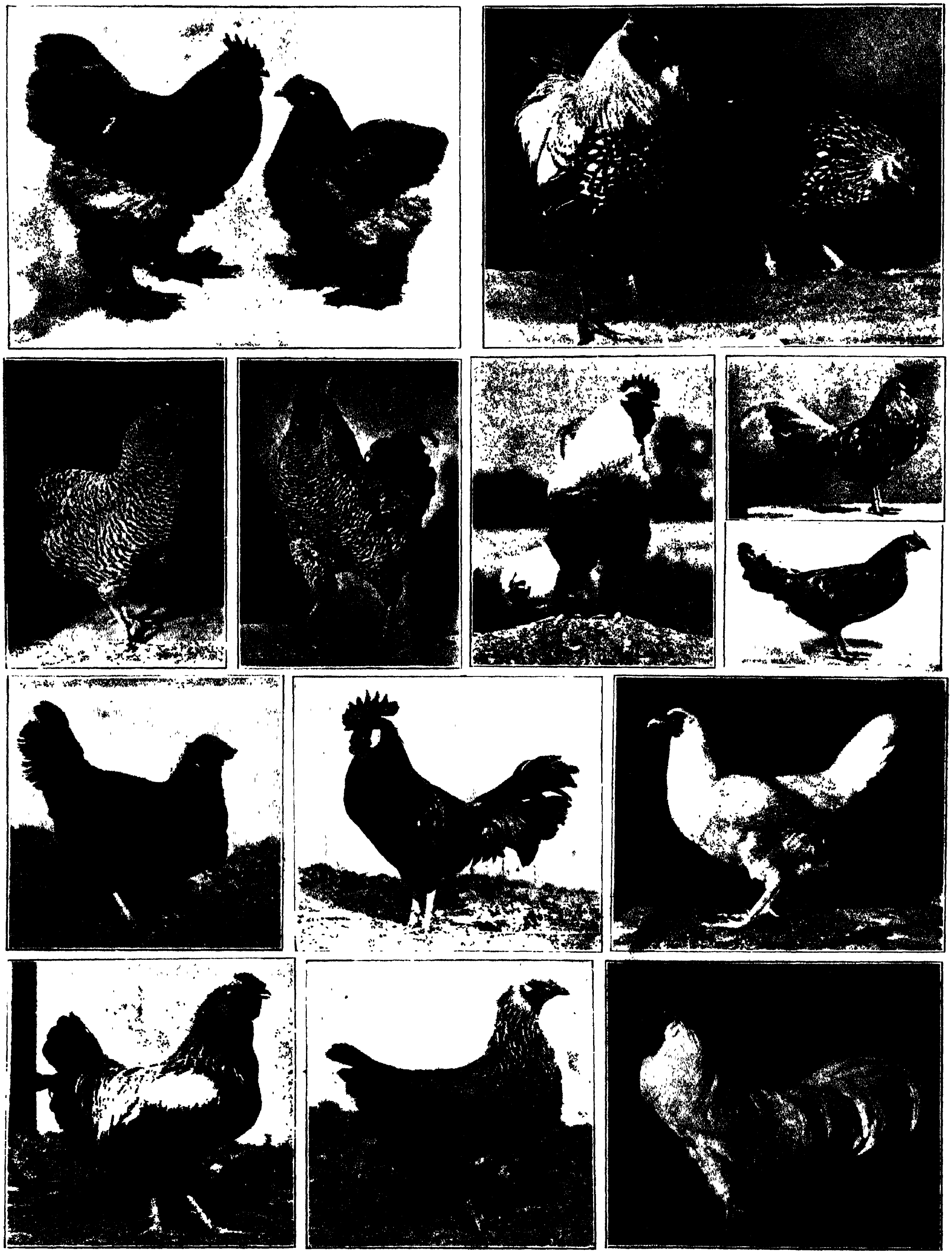

Plate XX. Prominent breeds of fowls

Top left, Buff Cochin; top right, Silver-laced Wyandotte. Second row, left, Barred Plymouth Rock hen and cock; right center, White Plymouth Rock; upper and lower right, Silver Spangled Hamburg cock and hen. Third row left, Black Minorca hen; center, Black Minorca cock; right, Single-comb White Leghorn hen. Bottom row left, Silver Wyandotte cock; center, Silver Pencilled Wyandotte hen; right, Single-comb White Leghorn cock.

Breeds and Types of Chickens. Figs. 571–581.

By *T. E. Orr.*

The acknowledged authority on poultry matters is the American Poultry Association. This is a body of fanciers, organized in 1873, now having a membership of nearly nine hundred persons. It publishes once in five years a book, "The Standard of Perfection," which describes and illustrates varieties considered worthy of recognition. This book prescribes rules for the management of shows and for the judging of fowls by both the score-card and the comparison methods. The one hundred and four varieties now recognized in the Standard may properly be classified under the two general headings, "practical" fowls and "fancy" fowls, as follows:

I. PRACTICAL FOWLS

American family	six breeds	seventeen varieties
Asiatic family	three breeds	eight varieties
Mediterranean family	five breeds	fourteen varieties
English family	three breeds	seven varieties
French family	three breeds	three varieties
Dutch family	one breed	six varieties
Indian family	one breed	two varieties

II. FANCY FOWLS

Polish family	one beeed	eight varieties
Game family	one breed	eight varieties
Game bantam family	one breed	eight varieties
Oriental Game family	two breeds	two varieties
Oriental bantam family	one breed	one variety
Ornamental bantam family	seven breeds	seventeen varieties
Miscellaneous	three breeds	three varieties

I. Practical Fowls

It is not easier to approximate perfection of show points in the first group than in the second, but each variety in the first group retains its popularity because of some practical point,—for example, the production of eggs or flesh, the former under peculiar circumstances or the latter of a particular quality, so as to make the breed or variety profitable to the man who pays little or no attention to the fancy points of form or feather. It has been said, and we think truthfully, that no variety can become universally popular that is not possessed of some characteristic that commends it to the attention of the practical, money-making American farmer.

The American family.

Dominique.—Of the seventeen American varieties, the Dominiques are certainly the earliest of origin. Some persons maintain that they originated in the West Indies. We do not know. Their form does not indicate this. The writer recalls having seen them in Virginia, on the farm of his grandmother, very close to their present form and feather, in the fifties.

In form they are very compact and deep-bodied. In weight the cocks average eight pounds, and the hens six pounds. In habit they are very active. They are rather slow of growth, but when mature the hens are persistent layers and excellent mothers. In color, each feather should be crossed with alternate light and dark bars of the same color as the well-known Barred Plymouth Rocks. Fine specimens of this variety are now rare. Their close, rosecombs, clean yellow shanks, and good commercial qualities should make them popular once more.

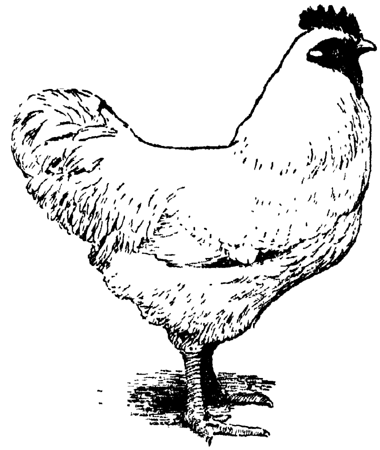

Fig. 571. White Plymouth Rock cock.

Java.—This breed, with its two varieties, Black and Mottled, is second of the Americans in antiquity. The Java had its origin in eastern New York. In the early sixties, it had reached such uniformity of both color and shape, particularly the Black variety, as to attract the attention of the public. It often grows larger than the Plymouth Rock. Its leading characteristics are a long, rectangular body and a deep yellow skin. No American variety breeds more true to form and color than does the Black Java.

The color of the Mottled Java is black and white, evenly broken in alternate splotches throughout the entire plumage. Both varieties have single combs and clean shanks.

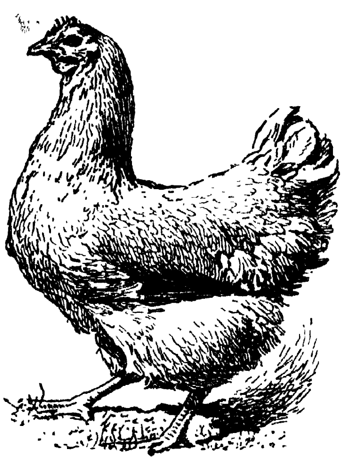

Fig. 572. Buff Plymouth Rock pullet.

Plymouth Rock.—This breed is divided into three varieties, the Barred, White (Fig. 571) and Buff (Fig. 572). The Barred variety originated in the sixties, in New England. Fowls by the name of Plymouth Rock had been produced fifteen years sooner, but they bore no relation in blood or type to the present Barred Plymouth Rock. Like all other American varieties, the Barred Plymouth Rock is of mixed origin. Two things are certain, both Dominique and Black Java blood were a part of the combination. There were other bloods used by the early experimenters, par-

ticularly that of Brahma and Cochin. However uncertain its ancestry, the result has been to give us in the Barred Plymouth Rock, the best-known and most widely disseminated American fowl. In shape, the Plymouth Rock is a nice average between its two ancestors, the Dominique and the Java. The back and body are rather long, breast broad and deep. The size of all three varieties is the same, the cocks weighing nine and one-half pounds and the hens seven and one-half pounds.

The wonderful popularity that fell to the lot of the Barred Plymouth Rock in the early seventies and the fabulous prices secured for good show specimens, made the American public want more of them, and it was not long until White Plymouth Rocks, true sports from the Barred variety, became known, and speedily became popular. The Buff variety came later, but to secure the buff color considerable foreign blood was introduced. All Plymouth Rocks have single combs and yellow shanks.

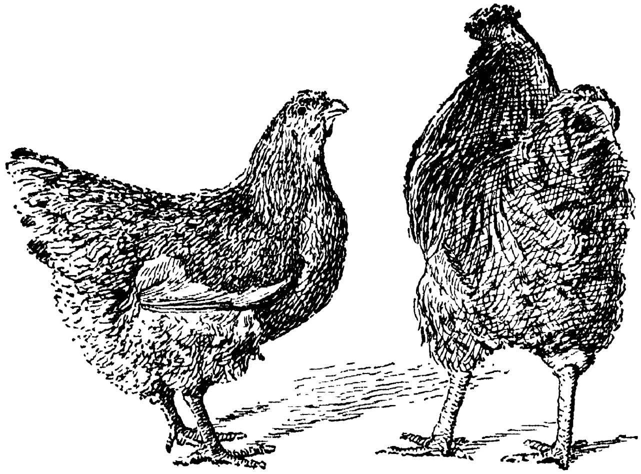

Fig. 573. Buff Wyandotte male and female.

As indicated by the names, the plumage of the White variety is pure white throughout, and that of the Buff pure buff throughout. Black feathers, or even black specks in the plumage of the White variety, are serious defects, and in the Buff variety black or white in any part of the plumage is equally objectionable. The skill of the breeder of the Barred variety is measured by his ability to secure a plumage, each feather of which is barred to the skin with alternate narrow crossings of a light and a dark color. No variety is more difficult to bring to perfection than this variety; but, when it is attained, high prices are the breeder's reward.

Wyandottes.—This is the earliest of the American breeds whose history we can trace with any degree of accuracy. The Silver variety is the original variety of this breed. The wonderful popularity of the Plymouth Rock in the seventies stimulated fanciers to produce something different that would surpass it and yield them large profit. They sought a fowl of plumper form and quicker maturity than the Plymouth Rock, and if possible of greater egg-producing capacity. Dozens of fanciers were at work along these lines, and several strains very similar in shape and color, and known by a half-dozen different names, such as Hambright, Hambletonian, Sebright Cochin and American Sebright, were known by 1880. Mr. Whittaker, of Michigan, seems to have had the most definite purpose, and to have worked along the most specific lines, and it was his description and the illustration made for him by B. N. Pierce in 1874, and published by Whittaker that same year, that won their admission to the Standard in 1883. An error in the description of the wing-bars of cocks, published in the Standard of 1883, and which was not corrected until the issue of 1888, made much confusion, and evidences of this widely disseminated error are still found.

In size, all Wyandottes are the same,—eight and one-half pounds for cocks, and six and one-half pounds for hens. In shape, all should be the same; a bird of curves, back short and broad, body deep and round, breast broad and deep, with a low-set keel, shanks short, strong and carried well apart.

The Silvers were the original Wyandottes. The Whites and Blacks are the only true sports from these. The Buffs (Fig. 573), Goldens, Partridge, Silver Penciled and Columbians each contained in their origin some outside blood to produce their several colors, unless it be one strain of the Columbians, which was produced by a single, almost accidental, cross of two other varieties of standard Wyandottes.

The Silvers, the original Wyandottes, have never been surpassed in "eggs early and often." Hundreds of cases are on record of pullets laying at five months. Before the writer is the daily record of a hen that in the first three years of her egg-production yielded 203, 202 and 201 eggs per year respectively. She is now hard at work on her fourth year and is doing well; and this hen has done all her work in the cold climate of Minnesota. This variety, having three times won the great international egg-producing contest conducted in Australia, stands without rivals in profitable egg-production. But of all the eight Standard varieties, the original Silvers are hardest to breed to Standard requirements of color. The back and shoulders of the male should be white, the saddle and hackle white, each feather with a black stripe in the center. The tail should be black. The breast and thighs of the male, these same sections of the female, and also her back and shoulders, should be covered with white feathers, each having a narrow black margin. This is difficult of attainment, but is beautiful almost beyond description.

The Golden Wyandottes are colored exactly like the Silver, except that golden bay is substituted for white. The plumage of the White, Black and Buff varieties is indicated by their names. The Partridge Wyandottes have the color-markings of the Partridge Cochins; the Silver Penciled Wyandottes have the color-markings of the Dark Brahmas; the Columbian Wyandottes have the

color-markings of the Light Brahmas. The White Wyandottes have far outstripped all of the other varieties of this breed in popularity. In fact, the entries at the greatest fall and winter shows, the past four years, reveal them to be more popular than any other standard variety. This is possibly accounted for by a popular prejudice in circles of commercial poultry against dark feathers, a prejudice that is more fanciful than real.

All Wyandottes have close-fitting rose combs, and all have an abundant, fluffy but close-fitting plumage. In the original Silvers, Hamburg and Dark Brahma blood were the chief elements. In the Buff and Partridge varieties, some Cochin blood was introduced. The admission of these eight varieties to the Standard covers twenty-three years, from the Silvers in 1883 to the Columbians in 1906.

Rhode Island Red.—During the twenty years prior to 1900, some thrifty fanciers and egg-producers in the southern part of New England labored diligently to produce a fowl of goo.. size, of marketable excellence, of large egg-producing ability, and of a reddish buff color. They succeeded in all these particulars, but they quarreled amongst themselves on some minor color requirements, and especially as to whether their favorites should have single combs, rose combs or pea-combs. It was not uncommon to find two or even three kinds of combs in the yard of the same breeder.

Finding that the Rhode Island Reds could never gain admission to the Standard with these diversities, the fanciers set about a more specific method of breeding, with the result that the Single-comb Rhode Island Reds were admitted to the Standard in 1904, and the Rose-comb variety in 1906. In 1902, the fanciers of the Pea-comb variety, under the leadership of Mrs. Metcalf, of Ohio, separated from the others, and having changed both the color and shape somewhat by the introduction of some Cornish Indian blood, secured the admission of their favorites under the name of Buckeyes in 1905.

The tail color of both Rhode Island Reds and Buckeyes calls for black. The former variety displays a red surface of body-plumage, with a red or salmon under-color, free from slate. The Buckeye surface color is a dark, rich, garnet, and the under-color allows a bar of slate-color next to the surface.

The standard size of Rhode Island Red cocks is eight and one-half pounds, and of hens, six and one-half pounds. The Buckeye cocks should be one-half pound heavier, and the hens one-half pound lighter. The body of both breeds is long ; of the Rhode Island Reds it is level ; of the Buckeyes it is carried at a slight elevation in front.

The Asiatic family.

Brahma.—This breed has but two varieties, the Light and the Dark. While the two varieties are of the same shape, the size is different. Dark Brahma cocks must attain a weight of eleven pounds, and hens eight and one-half pounds. In the Light Brahmas, each sex must go one pound heavier. Like all other Asiatic breeds, Brahmas are distinguished by heavy leg and toe feathering. They are also endowed with thick, close plumage, which enables them to endure with comfort a cold climate. This makes them good winter egg-producers, provided they have dry quarters and are not exposed to wind. Their great size and good quality of flesh make them a favorite in some markets, especially where capons are in demand. All Asiatics are slow of maturity, either for the table or for egg-production. While the ancestors of all the Asiatic varieties came originally from Asia, their present perfection is due more to American and English fanciers than to what they were when first imported.

The general color of the Light Brahma is white, with a black tail and black center stripes in both hackle and saddle feathers. The wing-color of both sexes is a combination of black and white too intricate to describe here. The appearance of the Light Brahma is most stately and commanding, and its great size and handsome coloring always win admiration.

The color of the Dark Brahma, except of the neck and tail, is entirely different. The wings of the cock are crossed by a heavy black bar, and the entire breast and body, also the leg and toe feathering, are black. The back, wings, breast and body of the female have for each feather a basis of gray on which are distinct, dark concentric lines of penciling, which in its perfection makes a very handsome bird.

Cochin: Buff, Partridge, White, Black.—The shape of all Cochins is the same, and their peculiarity is an appearance of massiveness and fluffiness. The heavy but short feathering of the Cochin, piled high on the back, and extending wide at the sides, makes it appear larger than the Brahma, but it is not, the weight being the same as that of the Dark Brahma; the cock weighs eleven pounds and the hen eight and one-half pounds. The excessive thigh and shank feathering of Cochins adds to their appearance of massiveness.

The names of the Buff, White and Black Cochins indicate their coloring. The Partridge variety is very different. This cock has a neck and back of bright red, shading to orange-brown color, each feather having a center stripe of black. His shoulders are red, and across the wing is a broad, black bar. His breast, body and thighs are black, also his tail. The hen has the same neck and tail color as the cock, but all her remaining surface color should be mahogany-red, each feather distinctly penciled with concentric circles of a rich dark brown. The combs of all Cochins are single, low, close on the head and evenly serrated with five distinct points.

Langshan: Black (Fig. 574), *White.*—There are two varieties of this breed and their names indicate their color. The Langshan is more up-standing than the Cochin, and in stateliness is a rival of the Light Brahma. The Langshan differs from other Asiatics in that he has longer shanks, is more scantily feathered, and that he carries both head and tail high, these members coming up close toward a meeting point, thus giving him the appearance of having a short back. This, however, is seeming

rather than real. The Langshan differs from all other Asiatics, and indeed from all American varieties, in that its skin is not yellow, but is a pinkish white. The bottoms of its feet, instead of being yellow as in the Cochin, must be a pinkish white. This peculiarity of the skin of the Langshan marks it as of peculiarly good table qualities. As is the case with all white-skinned fowls, the skin is thin, the flesh-fibers fine, and the flesh flavor very superior. This characteristic of superior table quality marks the Dorking, the Orpington and all three of the French varieties. It is in this particular, more than all others, that the English and French surpass Americans in the production of extra fine table poultry. The best American poultry markets are now insistently demanding white-skinned fowls, and shrewd American producers will soon be supplying that demand.

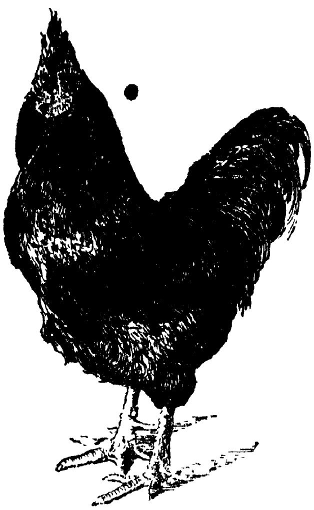

Fig. 574. Black Langshan cock.

The Mediterranean family.

Leghorn.—There are eight varieties of the Leghorn: Single-comb and Rose-comb Brown Leghorn (Fig. 575), Single-comb and Rose-comb White Leghorn (Fig. 576), Single-comb and Rose-comb Buff Leghorn, Single-comb Black Leghorn and Single-comb Silver Duckwing Leghorn. The size and shape of all are identical, except as to shape of combs indicated by the variety names. Leghorns had their early homes in southern Europe. The coloring has been greatly modified by American fanciers in the past forty years.

Early maturity and great activity characterize all the Leghorns. Give them dry, warm quarters and they all produce large numbers of eggs. Their large combs, pendulous on the females, are easily injured by frosts, so for winter egg-production warm houses are essential. Leghorn eggs are white, as are the eggs of all Mediterranean varieties. This color of egg is the favorite of the New York City market, and the White Leghorn is the favorite of the egg-producers who cater to that market. A large majority of the cockerels of this variety are marketed by their producers as broilers at two months of age. This combination, White Leghorn eggs and White Leghorn broilers, has proved very profitable, as both products command high prices.

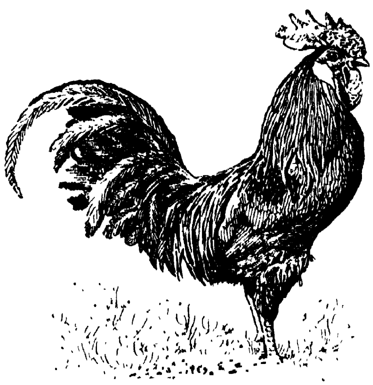

Fig. 575. Brown Leghorn cock.

The Brown Leghorn is very peculiar and very handsome in color. The color of the cock is the same as that of the Partridge Cochin cock already described (page 565). The color of the Brown Leghorn hen is nearly the same as that of the Partridge Cochin hen (page 565) as to neck, wings and tail; but her back, shoulders, breast and body, instead of the distinct penciling of the former, have for the basis of each feather a delicate brown on which a darker shade of brown is finely and evenly stippled.

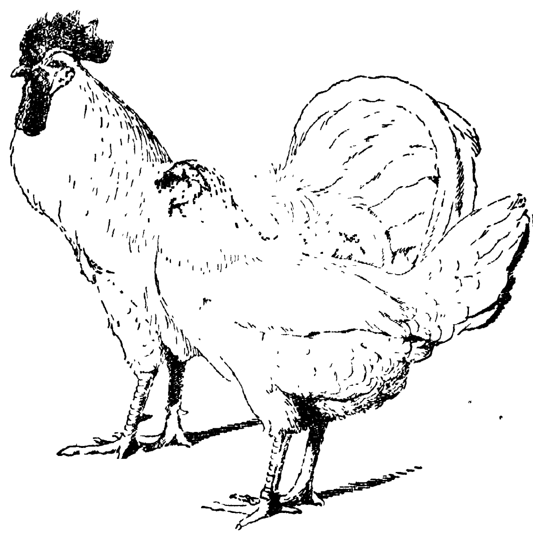

Fig. 576. White Leghorn male and female.

Minorca: Single-comb Black, Rose-comb Black, Single-comb White.—The shape of the Minorca is peculiar. It has a long body carried rather upright, deep at the breast with the back tapering sharply toward the tail, and this organ long and carried rather low. The comb is rather large. The ear-lobes are large and pure white. The last two particulars are characteristic of all Mediterranean varieties. The cocks carry a weight of eight pounds and the hens six and one-half pounds in the Rose-comb variety; each sex of the Single-comb variety is one pound heavier.

White-faced Black Spanish.—This is one of the oldest and best-known Mediterranean varieties, but, of late years, few good specimens are seen at our shows. The shape and color and the shape of the comb is the same as of the Single-comb Minorca, but each sex weighs one pound less. The peculiarity of this breed is its white face, a very exaggerated enlargement of the white ear-lobe of other Mediterranean breeds.

Blue Andalusian.—This is one of the later and

one of the most beautiful additions to the Mediterranean family. In shape, it is similar to other members of this family. In size, it is about midway between the Leghorn and the Minorca. The cock weighs six pounds and the hen five pounds. The plumage is a clear, slaty blue, each feather delicately laced with a darker shade of blue, approaching black.

Ancona.—This is the latest addition to the American Mediterranean family, although it has long been bred in Europe, especially in England, where the color demand for shanks is yellow, while ours allows yellow, shaded or mottled with black. In size, the Ancona is about the same as the Leghorn. In color of plumage it is the same as the Mottled Java, already described (page 563).

The English family.

Dorking.—On the Dorking, more than on any other breed, the English people have established their enviable reputation for producing the choicest of poultry. The skin of this breed is white, which indicates the excellence of its flesh quality r table use. [See comments on this subject under *Langshan*, page 565.] The Dorking has a shape peculiarly its own. The body is long and deep, carried at a slight elevation in the males and rather level in the females. It carries an abundance of flesh in the most desirable sections. The Colored Dorkings are the largest. The cocks weigh nine pounds and the hens seven pounds. The White Dorkings are the smallest, the cocks weighing seven and one-half pounds and the hens six pounds. In size, the Silver-gray variety, the most beautiful in plumage, is between the two sizes just given. There is no bird in our American Standard more beautifully colored than the Silver-gray Dorking hen. Her back, wings and breast have gray as a base, each feather delicately stippled with a darker shade. All Dorkings have an extra or fifth toe.

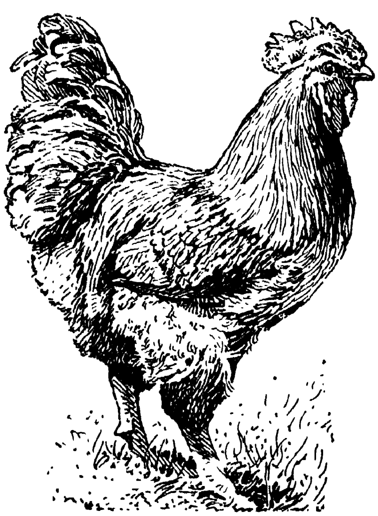

Fig. 577. Buff Orpington cock.

Redcap.—In size, this bird is about the same as the White Dorking. In color, the male has various mixtures of red and black, the female of brown and black. An enormous rose comb adorns the head of both sexes.

Orpington: Buff (Fig. 577), *Black, White.*—These are the only varieties of this breed to be accorded admission to the American Standard, although other varieties are sure to seek admission soon, notably the rose-comb varieties with the same colors as the above three, these all having single combs.

The late William Cook, who did more to promote the Orpington in England, Africa and America than any other individual, said that the chief origin of the Orpington was in Dorking and Cochin

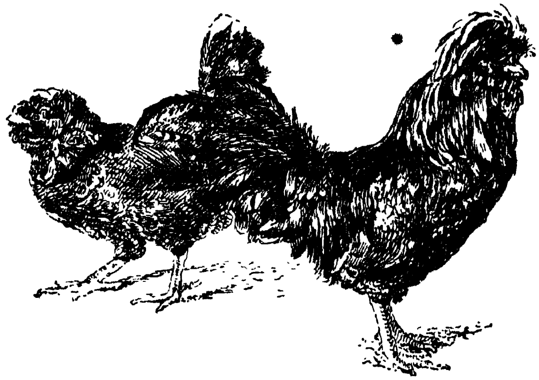

Fig. 578. Houdan fowl.

blood. The color of the skin indicates Dorking relationship, and the tendency to feathered shanks, especially on the Buff Orpington, indicates some Cochin blood. From their peculiar shape, somewhat different from that of the Buff Orpington, we should imagine that the Black Orpington and White Orpington dipped into both Langshan and Cochin blood. Be their origin what it may, the Orpingtons have taken a strong hold on the affections of American fanciers, and we predict a large increase in their number in the near future, to enable the producer to supply the demand for white-skinned fowls, referred to under Langshan (page 565).

The Orpington has in reality a long body, although its abundant plumage, particularly of the black males, gives it the appearance of having a short back and a short body. In size, it is larger than the Plymouth Rock, the cock weighing ten pounds and the hen eight pounds. To carry this enormous weight, it should stand on short, heavy shanks. The Orpingtons are good producers of large, brown eggs.

The French family.

Houdan.—The Houdans (Fig. 578) are the best known in America of the French breeds. In color, they are the same as the Mottled Java and Ancona. The cocks weigh seven pounds and the hens six pounds, but both sexes often run heavier. Houdans have head ornaments of both crest and beard. They are good producers of white eggs and also have the white skin and fine flavor so dear to the heart of the French epicure. The Houdans, like the Dorkings, carry the extra or fifth toe on each foot.

Crevecœurs (Fig. 579) are black fowls with both crest and beard. In size they are half-way between the Plymouth Rock and the Wyandotte.

La Fleche fowls are also black, but do not have the crest or beard. The cocks weigh eight and one-half pounds and the hens seven and one-half pounds.

With their superb methods of feeding, the French producers frequently bring capons of this variety to a weight of twelve pounds, and poulards to ten pounds each. The fact that the two last-named French breeds, when properly fatted and dressed, command the highest prices in the most fastidious market in the world should help to dissipate the American prejudice against fowls with black plumage.

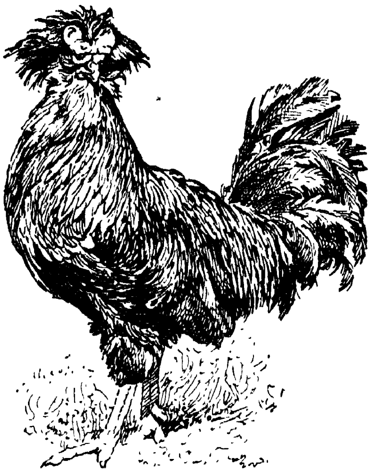

Fig. 579. Crevecœur cock.

The Dutch family.

Hamburg: Golden Spangled, Silver Spangled, Golden Penciled, Silver Penciled, White and Black.—This family is often classed erroneously among the purely fancy breeds. For a half century or more it has maintained a right to the name. "Dutch Everlasting Layers," and Dutch eggs form a large part of the eggs consumed in the great city of London. The Hamburg is about the same size as the Leghorn, and like them it lays a large white egg. Its coloring is too intricate for a description here, but this is a breed well worth more attention than it receives in this country.

The Indian family.

Indian: Cornish and White.—The two varieties of this family, often called Games, erroneously, evidently trace to Indian origin, the Cornish variety still bearing a strong resemblance to the red Aseel. They came to England, and various crosses on the original importations with the Black-breasted Red Game and with the Black Sumatra have produced the present Cornish Indian. The White Indian is not so easily traced. Many persons think it is simply a sport from the Cornish. Its similarity in shape makes this the simplest solution. The Indian is a bird of strong proportions, and so fine is his texture that his weight deceives the uninitiated. The cocks weigh nine pounds and the hens six and one-half pounds. The beaks and shanks are yellow. The back and wings of the cock are a beautiful mixture of black and red. The tail and breast are black. The hen's back, wings, breast and body are a rich bay, penciled with black. The Indian makes a fine market bird and is particularly good for crossing on Brahmas and Cochins for certain markets.

II. Fancy Fowls

We now come to a consideration of those breeds and varieties that are seldom if ever bred for practical purposes, for table use or for egg-production, but are bred as the fads and pets of fanciers who admire their peculiarities of form or feather, and have little regard for the question of profit or loss in their poultry transactions so long as their own artistic or esthetic tastes are gratified. Not being of strictly farm value they have little place in a work of this nature.

The Polish family.

Polish: White-crested Black, Bearded Golden, Bearded Silver, Bearded White, Buff-laced, Non-bearded Golden, Non-bearded Silver, Non-bearded White.—These eight varieties constitute the beautiful Polish family, probably the joy and pride of more strictly fancy fanciers than any other family. The Polish are easily controlled and confined, by reason of their immense crests, but require good care and housing, as they cannot endure exposure in snow or rain. Four of these varieties, as their names indicate, have, in addition to their crests, ample beards. The color-markings of the Polish varieties are too elaborate to allow detailed descriptions here. With good care, Polish hens produce a good supply of choice white eggs.

The Game and Game bantam families.

Game: Black-breasted Red, Brown Red, Golden Duckwing, Silver Duckwing (Fig. 580), *Birchen, Red Pyle, White, Black.*—These eight varieties of standard Games have each its counterpart in bantams. The standard or exhibition Game has a style peculiarly its own. The corresponding bantams differ only in size. The standard Game differs greatly from the pit Game. The latter is bred for fighting, the former for exhibition at shows, where the bird that stands highest and straightest, looks the fiercest and has the most correct plumage wins the prize.

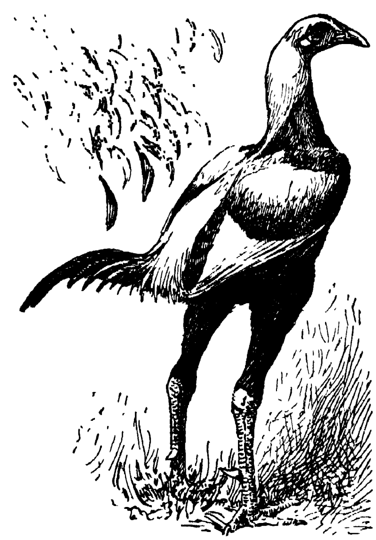

Fig. 580. Silver Duckwing cock.

Oriental Game and bantam families.

Black Sumatra.—This is a medium-sized bird with long drooping tail-plumage of very rich greenish black. It is much used in making certain crosses.

Black-breasted Red Malay.—This is a large, handsome bird. The cock is twenty-six inches high and weighs nine pounds; the hen is eighteen inches high and weighs seven pounds. The color of the cock is chiefly a rich reddish brown ; that of the hen is dark brown with black in some sections.

Black-breasted Red Malay bantam.—The Malay is also produced in bantam size, which is very popular.

Ornamental bantam family.

Sebright: Golden, Silver.—These are proud little birds. The cocks and hens are feathered alike. The plumage of the Golden Sebright has a yellow base, and each feather is distinctly laced with black. The plumage of the Silver Sebright has a white base, and the same black lacing as the Golden.

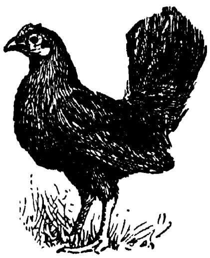

Fig. 581. Rose-comb Black bantam.

Rose-comb bantam: Black (Fig. 581), *White.*—Both black and white types are found among these. Both sexes of both varieties have a proud carriage, a large, white ear-lobe and a long tail.

Booted White bantams.—The peculiarity of this breed is a heavily feathered vulture hock, which gives it the appearance of wearing boots.

Brahma bantams: Light, Dark.—These are simply the two standard varieties of this name in miniature. It has been very difficult to get them sufficiently dwarfed in size.

Cochin bantam: Buff, Partridge, White, Black.—Each of the four standard Cochin varieties has its corresponding bantam, very grotesque little creatures. The Standard weight for cocks is thirty ounces and for hens twenty-six ounces. Weights four ounces higher disqualify.

Japanese bantams: Black-tailed, White, Black.—The leading characteristic of Japanese bantams is that they are seemingly almost legless, that their long wings touch the ground, and that their big, high tails come as near as possible to touching the back of their heads.

Polish bantams: Bearded White, Buff Laced, Non-Bearded.—These follow the standard Polish varieties already referred to, except in size. The cocks should weigh about twenty-six ounces and the hens about twenty-two ounces.

Miscellaneous breeds.

Silkies.—These are a peculiar white fowl of small size, with bluish red face and comb. Their leading characteristic is that their feathers are without quill or web, thus giving them a plumage that is soft, downy and fluffy, from which the name is derived. (Fig. 529.)

Sultans.—These are booted Polish fowls, with both muff and beard. Their plumage is white. The comb should be invisible or very small V-shaped with two small spikes. The crest is large, full and compact, the feathers falling backward.

Frizzles.—These are fowls of any size or color, but having the tip of each feather turned back so as to give them a peculiar ruffled appearance. (Fig. 528.)

Literature.

For references, see page 527.

Ducks. *Anatidæ.* Figs. 582–585.

By *Charles McClave.*

The domestic duck is a web-footed, short-legged fowl that is raised chiefly for its meat. The eggs cannot compete on the market with hen's eggs, and are seldom offered for sale except for hatching purposes. It is the general opinion of naturalists that the domestic duck of today is a descendant of the wild Mallard (*Anos boschas*), and that different types and colors have been produced only after many generations of careful selection and breeding.

The American Standard of Perfection recognizes twelve varieties of domestic ducks as follows: Aylesbury, Rouen, Pekin, Cayuga, Crested White, Indian Runner, Blue Swedish, White Muscovey, Colored Muscovey, Gray Call, White Call, and Black East India. These twelve varieties comprise all colors, types, and sizes of the duck family, from the little two-and-one-half-pound Call to the twelve-pound Muscovey or Pekin.

Aylesbury.

The Aylesbury duck is the leading English market variety. It is native of the county of Aylesbury, England. It is to Europe as a market duck what the Pekin is to America. The Aylesbury is slaty white in color, of large size, with flesh-colored beak and yellow shanks and feet. It is a good layer, rapid grower, and ranks high as a market variety.

Rouen. (Fig. 582.)

The Rouen duck is a descendant of the wild Mallard, which it resembles in color. By careful selection and breeding it has attained more than twice the weight of the Mallards. Some writers have designated it as a native of Rouen, a city in the province of Normandy, which is noted for its fine poultry, but this cannot be verified, as larger and better specimens can be found in both England and America than in Normandy. The Rouen is the largest and most popular of all colored market varieties. The standard weight of mature specimens is nine pounds for drakes and eight pounds for ducks.

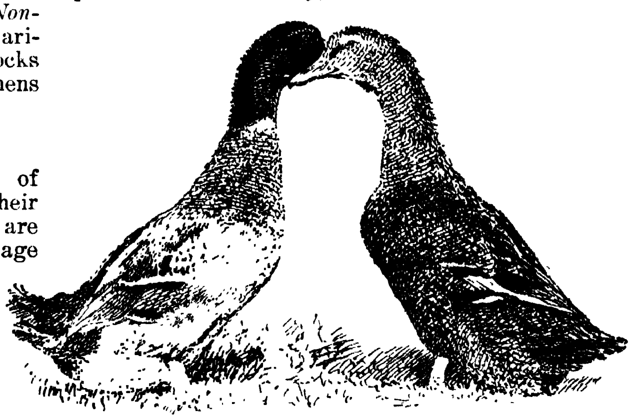

Fig. 582. Rouen ducks.

Black Cayuga.

This is the largest solid black duck known. It is strictly an American production and first made its appearance about Lake Cayuga, New York, from whence it derived its name. It is of fair size, a mature pair weighing fifteen pounds. The body is of good length. It is a good layer, the young grow rapidly, and as a market variety it ranks with the Rouen and Aylesbury.

Pekin. (Fig. 583.)

The Pekin is the greatest market duck of modern times. It was first imported to America from China in 1873. For two or three years following this importation, Pekin duck eggs for hatching were difficult to secure at ten to thirteen dollars per dozen. The Pekin is today the largest white duck in existence, exhibition specimens frequently weighing as high as ten to twelve pounds each. As a market variety, it outranks all others. Without doubt, there are more Pekins grown for market in America than all other varieties combined. The head and beak are long, and of good size; beak orange-yellow in color; back, breast and body long, broad and deep, with deep keel; color creamy white. It is a good layer, feathers early and matures rapidly.

Crested White.

This is a medium-sized white duck, with large white crest or topknot. It is about two-thirds the size of the Pekin, and resembles it in color and shape of body, with the exception of the crest. It is strictly an American production. It is a good

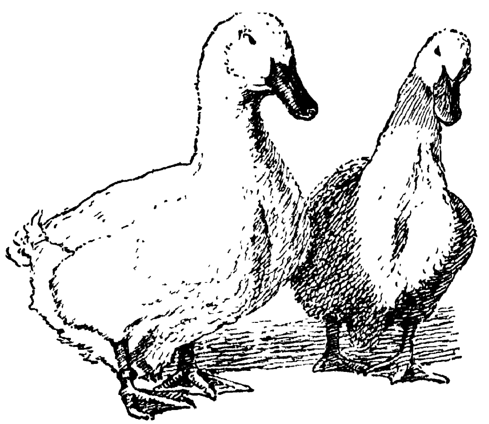

Fig. 583. Pekin ducks.

layer, and the young grow rapidly. The Crested White is an excellent market variety, and at the same time is very ornamental, so that it is in demand.

Blue Swedish.

The Blue Swedish is the latest acquisition to the standard varieties. It is an English production, and has been bred in England for several years. It is of good size, mature birds weighing fifteen pounds per pair, and is of the same general character as the Pekin, except in color. The color is a uniform steel-blue throughout, except on the bib or front of the breast, which is clear white and heart-shaped, extending to the throat. The beak in drakes is greenish blue in color, and in the duck smutty brown, with dark brown blotch, the eyes deep hazel; shanks and feet reddish brown.

Indian Runner. (Fig. 584.)

This is a small variety midway in size between the Call and the Crested White. It originated in England. It is termed the "Leghorn of the duck family" because of its great laying capacity. It is, without doubt, the best-known layer of the aquatic family. In color it is entirely different from any other standard variety of ducks. The head is long and flat, light fawn in color, cap and cheek-markings light fawn; bill straight, green in color with black bean at tip; eyes hazel; neck white from head to point where breast-markings begin; back light fawn or gray; breast light fawn, evenly divided half-way between point of breast-bone and legs; body light fawn, the rear half white; shanks and feet orange-yellow; carriage very erect, almost in a perpendicular form. The young feather rapidly and come to maturity earlier than the larger varieties.

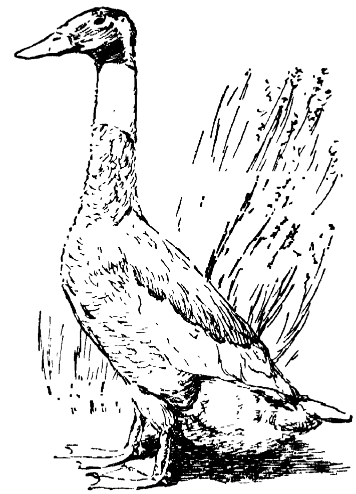

Fig. 584. Indian Runner duck.

Black East India.

The Black East India duck is an exact counterpart of the Black Cayuga, except in size. It is rated with the Call as the bantam of the domesticated duck family. The best authorities inform us that it is a "sport" from the common or wild Mallard (*Anos boschas*). It has the same general characters as the Mallard. While it should be solid black in color, many specimens have white on the breast, which is a disqualification. It is more freely bred in England than in America. Really good specimens are scarce and hard to secure at any price.

Colored Muscovey. (Fig. 585.)

The Colored Muscovey is an entirely distinct species from all other standard varieties of ducks. It is a native of South America and inhabits the country along the equator from Guiana to Paraguay. It is the native wild duck of that locality and is not a migratory bird, as are nearly all other varieties of wild ducks. While it is somewhat slow and inclined to be awkward on foot, it is very

active on wing and can fly miles with a very little effort. The males are about twice the size of the females and pugnacious in disposition, especially at breeding time. The Muscovey will cross with other domestic ducks, but the progeny are useless for breeding purposes.

The Colored Muscovey is of good size, black and white in color, the black predominating. The most peculiar characteristic is that the side of the head and the region around the eye are without feathers and are carunculated or corrugated and scarlet in color. Unlike many other varieties, this duck builds her nest and never scatters her eggs. She will sit, hatch and rear her young with diligent care. It requires the Muscovey five weeks to hatch, while other varieties hatch in four weeks. It is the duck that never quacks.

White Muscovey.

The White Muscovey has been bred from the Colored variety by careful selection of the whitest specimens for many years, and now breeds true to color. The young usually show some black at the top of the head and frequently on the back, underneath the wings, but this disappears after the first molt. Unlike others, it molts but once a year. The White is the same as the Colored variety except in color.

Gray Call.

The Gray Call duck is the bantam of the duck family, and weighs only four to five pounds per pair. The color is identical with that of the wild Mallard or the Rouen. It is an ornamental variety and is used principally as a decoy to bring down wild ducks, and for ornamenting the waters of public and private parks. While domestic in its habits, it is very active on the wing and flies as well as any wild variety. The female prepares her nest very carefully in a secluded place and lays ten to fourteen eggs; she is a good mother, rearing all her young, barring accident. The young are rapid growers and come to maturity at eight to ten weeks old.

White Call.

This has the same general characteristics as the Gray Call, except that in color it is a spotless white. The White has never been so popular as the Gray and good specimens are not plentiful.

Wild ducks of America.

There are more than fifty known species of wild ducks scattered over North America from the Canal zone to the Arctic ocean. Some varieties are much more numerous than others. It will be possible here to mention only a few varieties and to describe the one or two most important. The most important are the Wood duck, Mallard, Pintail, Shoveller, Cinnamon Teal, Blue Wing Teal, Green Wing Teal, Widgeon, Godwall, Mottled duck, Florida Dusky duck, Black duck and others. All of these are what are termed non-diving varieties, and derive most of their living from the vegetation found in the shallow water of streams, pools and marshes. The fresh-water ducks also relish any kind of grain or animal food found in the water. All varieties are practically migratory in their habits, passing the summer and nesting in the North, and wintering in the South.

There are fully twenty-five species of diving ducks, including the well-known Canvas-backs, Red-heads, Broad-bills, Labradors, American Eiders, Velvet Scooter and many others. Nearly all varieties migrate more or less at night, especially when they are disturbed by hunters, and frequently pass the day on the water far from shore as a means of protection.

Wood or Carolina duck (*Aix sponsa*).—This is the handsomest and most gorgeously colored of any American variety. While a migratory bird, it does not go so far north as most other varieties of wild ducks, and confines itself at all seasons of the year largely to the United States. The adult male has

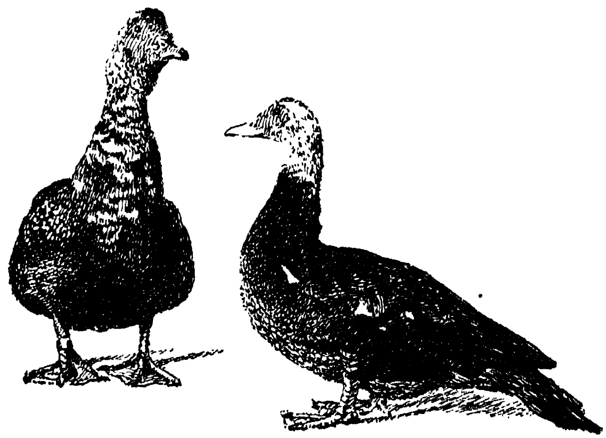

Fig. 585. Colored Muscovey ducks.

a long flowing crest, extending backward nearly to the shoulder. It is purple and green in color, with bright metallic reflections. Two narrow lines of white, one starting from the upper base of the bill, the other at or behind the eye, pass backward to the point of the crest; the throat and side of the neck are white, nearly enclosing the violet-black back of the head. The breast is chestnut, shaded with purple, and spangled with triangular patches of white; the wing coverts and back are purple and black, with rich reflections; the sides of the breast are marked with a broad black bar; the sides of the body are barred with fine black lines with yellowish brown ground or undercolor, the longer feathers ending with a white bar. The bill is deep red or scarlet, with black at the base, and black bean or nail; eyes bright red with scarlet eyelids; legs and feet dusky yellow. The female is similar to the male in color, but much duller in shade.

The Wood duck is rivaled only by the Mandarin duck of China, which is a smaller variety and somewhat less gaudy in color. The Wood duck prefers a secluded place, near a small lake or swamp where trees abound. The nest is usually made in hollow trees near the water, and is composed of feathers

and down only, plucked by the duck. Should the nest be far from the water, the young are carried by the mother in her beak, one at a time. Here they are at home, and like other wild varieties come to maturity in a very short period.

The Mallard duck (*Anos boschas*) is the most numerous of all North American varieties, and is found more or less in Europe and parts of Asia and northern Africa. In color, it is the same as the standard Rouen; medium in size; head of the male clear lustrous green; bill greenish yellow; eyes dark hazel; neck green, with distinct white ring nearly meeting at the back; breast clear purple, brown extending well back; back ashy gray, shaded with green; wings grayish brown shaded with green. The duck is entirely different in color from the drake, the entire plumage being light brown penciled with dark lustrous brown throughout.

Literature.

Geo. E. Howard, Ducks and Geese: Standard Varieties and Management, Farmers' Bulletin No. 64, United States Department of Agriculture (1906). [For further references, see page 527.]

Geese. *Anatidæ.* Figs. 586–590.

By *Charles McClave.*

The goose is a water-fowl raised for its meat and feathers, and also to some extent for ornamental purposes. The breeding and rearing of domesticated and wild varieties of geese is an industry that is not only interesting in many ways, but of value from a commercial standpoint.

The goose may be said to be midway in general appearance and size between the swan and the duck. It is much smaller, with shorter body, wing and neck than the swan, and much larger than any known variety of ducks. The beak of the goose is different in form from that of the duck, being narrower and deeper and more like that of the swan. The tarsus or shank—that is, the part of the leg not covered by feathers in the goose is covered by naked skin, marked with small lines, enclosing sections like meshes of a net. In the duck family this is very different; the front of the shank or tarsus is covered with scales or scutellæ, one overlapping another and forming a perfect covering just as the scales cover a fish. In the goose the tarsus is said to be reticulate, while in the duck it is said to be scutellate.

The origin of all our domestic and standard varieties of geese, except the wild or Canadian, is said to be the European gray-lag variety (*Anser cinereus*). By careful selection and breeding for a great number of years, man has wrought many changes in color, type, and general characteristics of the domestic varieties. The geese that excited the attention of the guard by their loud noise and saved the Roman capitol from destruction by the enemy, were of a very different type from our improved varieties of the present day.

The varieties of geese recognized by the American Standard of Perfection are the African, Embden, Toulouse, White Chinese, Brown Chinese, Wild or Canadian and Egyptian. All are natives of the eastern hemisphere except the Wild or Canadian. The first three varieties are generally designated by breeders and specialists as the "heavy weight" or "market" varieties of the goose family. Mature geese, when fattened for market, weigh seventeen to twenty pounds each; single specimens have been known to reach more than twenty-five pounds, but the latter figure is an extreme weight.

The following notes on African, Embden and Toulouse geese, not prepared by the writer of this article, are inserted by the Editor to complete the discussion.

African.

African geese rank with the Embden and Toulouse in size, and are considered more prolific than either. They are strong, vigorous and active birds. They are characterized by a large head, bearing a pronounced black knob, and a heavy gray dewlap under the throat. The neck is long, back broad and flat, breast full and round, body large and upright. The thighs are short and plump, and the shanks medium long and dark orange colored. The wings are of good size, and fit close to the body. The plumage of the neck is rather light gray in color, traversed from the head to the body by a stripe of dark gray color. The breast is gray, the under part of the body and thighs a lighter gray, and the back dark gray. The wings and tail are dark gray. The standard weights are given as follows: Mature gander, 20 pounds; mature goose, 18 pounds; young gander, 16 pounds; young goose, 14 pounds.

African geese are most profitable because of their prolificacy and early maturity. Nine-pound market birds are ready in ten weeks. Their dark bill and skin is against them, and they are consid-

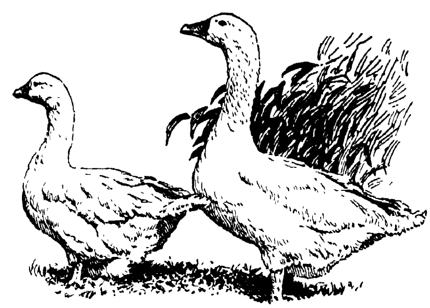

Fig. 586. Embden.

ered difficult to pick. But the flesh is fine-flavored, and esteemed for the table. The ganders are sure breeders, and mate readily with any geese and with large numbers. The females are splendid mothers, and fairly good layers.

African geese are an old variety and were brought to America at an early date, variously known as African, India and Guinea geese. They have not been much shown, and consequently are not so well known as some other breeds, but are highly prized by a few breeders.

Embden.

The beautifu. white plumage, square, compact body, and tall, erect carriage of the Embden make it a very attractive bird. It is not so prolific, perhaps, as the Toulouse, averaging only about twenty eggs in a season, but it is highly esteemed as a practical bird. The neck is long and massive-appearing, carrying rather a large head and a medium-sized, orange-colored bill. The back is slightly arched, the breast round, deep and full, shanks short, stout, and deep orange in color, the thighs strong and well-proportioned, toes straight. The wings are large and strong and the tail short. The eyes are bright blue, indicating vigor and attention. The standard weights are given as follows: Mature gander, 20 pounds; mature goose, 18 pounds; young gander, 18 pounds; young goose, 16 pounds.

Embden geese were originated by the north Germans, and especially those living in or near the province of Westphalia.

For breeding, it is well to choose a bright, active gander of good parentage, that is two to five years old. The goose should have similar qualities, and be clean and compact. Fall or early winter is the best time to mate. The gander and geese, one to three in number, should be put together and isolated until they become acquainted. Embden geese will breed profitably until ten to twelve years of age, but they are not generally allowed to do so. They like to hide their nests, and it is well to place the nests in out-of-the-way places, free from disturbance. A few nest-eggs should be provided so that the eggs may be removed each day, and stored at a temperature of 45° to 60°, until enough for a sitting have been secured. By that time the goose will be broody. Incubation takes thirty days. If the eggs are hatched under a hen, she will need attention at hatching time, until she gets familiar with her strange brood.

Toulouse.

Toulouse geese are an old French breed, and have long been popular in France for their superior fattening qualities and hardiness, making them very profitable. They derive their name from the city of Toulouse in France. They are bred largely on farms in America, and are in demand on the market. They are less esteemed for table purposes than some other breeds, owing to the coarse and flabby nature of the flesh. They are late maturing and prolific, averaging about forty eggs in a season.

Toulouse geese are blue-gray in color, marked with brown; the head is gray, the neck dark blue-gray, the back dark gray, the breast a light gray or steel-blue, the belly and under surface of the tail white; the shanks and feet are deep orange-red colored, and the bill is orange colored. The primaries of the wings are brown, the secondaries a darker brown, edged with lighter gray, the coverts dark gray. The head is rather large but short, the bill short and stout, neck medium long and well carried; body compact, medium length, deep, the belly almost touching the ground; back broad, moderately long, slightly arched; breast broad and deep; wings large, strong, folded close to the body; tail short; thighs and shanks stout. The standard weights are given as follows: Adult gander, 20 pounds; adult goose, 18 pounds; young gander, 18 pounds; young goose, 15 pounds.

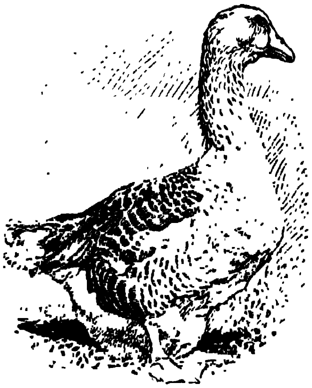

Fig. 587. Toulouse goose.

The comparative value of the different breeds for market purposes is a matter of opinion. African geese are hardy, good breeders and prolific; otherwise they are not so good for market purposes as either the Embden or the Toulouse. African ganders are frequently used to cross on other breeds, but they are pugnacious, quarrelsome and hard to handle. The Embden is preëminently the market goose for family trade; especially is this so where producer and consumer deal direct.

Young geese are often as good or better breeders than old. Breeding qualities are to be judged by results rather than by age. It is well to keep the good breeders as long as they produce satisfactorily. Geese that have been good breeders should not be condemned on one season's failure. All breeding geese have their "ups and downs," and results are not always good. It is better to set all but the last eggs under hens; the latter are easier to handle, and the goose will usually lay two litters.

White and Brown Chinese. (Fig. 588.)

The White and the Brown Chinese (*Cygnopsis cygnoides*) have the same general characteristics, but are entirely different in color. The original Chinese were colored and the White has been bred from sports. It is thought that no entirely white variety of geese existed among any known wild species of the goose family. These two varieties are native of China, and are bred in Europe and America in large numbers.

The Chinese are the most ornamental of all domestic varieties of geese. For ornamenting the lakes and lagoons of public and private parks they rank high, even rivaling the European swan in this respect. They are also a practical variety. In egg-production they outrival even the famous Toulouse. As a market goose, the Chinese are of very superior quality. The bodies are plump and round and the meat is of excellent quality. As feather-producers they are also valuable, being covered with a good coat of soft feathers and fine down. They are of medium size, mature specimens weighing ten to fourteen pounds each according to flesh. In general appearance, the Chinese have long arch necks, carried very upright, with a large round knob or protuberance at the base of the beak—the larger the knob the better. They dis-

play a short erect body and carriage, giving them a novel appearance. They are especially valuable on farms on which marshy or broken land by stream or brook abounds, for this is their natural home. During the spring and warm months they gain nearly their entire living from pasture and water. During the winter, they need the protection of an open shed, and if supplied with clover hay and other rough fodder require only a small amount of grain each day. The breeding geese should be fed sparingly on corn or other grain, as fattened specimens are poor egg-producers and eggs from them hatch few goslings.

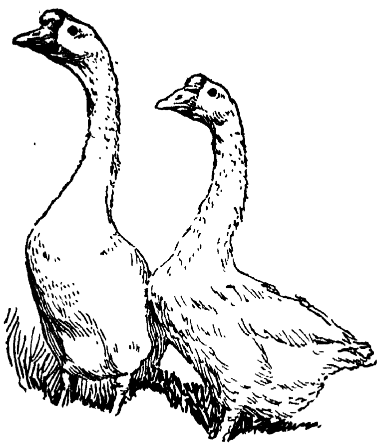

Fig. 588. White Chinese geese.

Experience has taught that it is best to mate two geese with one gander, although some ganders will mate with three geese. When large flocks are kept together, they usually mate in pairs and trios, and at laying time the ganders become pugnacious among themselves and fight viciously. It is advisable to allow the goose to sit and hatch her young, but the eggs can be hatched by chicken hens and reared by hand with good success. Should the latter method be adopted, the goose should be removed to new quarters as soon as she begins to be broody, and in a few days she will lay again. After the second laying it is well to allow the goose to hatch and grow the young. The young grow rapidly from the shell, and at four months of age are nearly mature. The gander will always care for and protect the young as well as the goose. The young hatched and cared for by the chicken hens can be turned over at any age to the flock, as the ganders will fight for the young at any age, and every old gander in the flock will endeavor to father the young goslings.

Wild or Canadian. (Fig. 589.)

The American wild or Canadian goose (*Branta Canadensis*) is a native of North America from the gulf of Mexico to the Hudson bay country and even Alaska. It is a migratory bird, spending the winters in southern United States and in Mexico and California. In the early spring great flocks are seen passing northward, beyond the eye and habitation of man to the silent desolations of unknown countries. It seeks the wild solitudes uninhabited by man, on the shores of lakes and marshes. It usually nests near the water on elevated patches of ground, and frequently on muskrat houses made of reeds in the water. The nest is carefully made and protected with diligent care by both gander and goose. The goose does not begin to lay until three years of age, and produces five to eight eggs of large and uniform size. Invariably all are fertile and each brings forth a strong, vigorous gosling. As soon as all are hatched, the young are taken to the water by the parent birds, where they feed mostly on vegetable matter and water insects. The young are very rapid growers and come to maturity in about twelve weeks, while other varieties of our domestic geese require four to five months to reach maturity. The Canadian Wild geese mate only in pairs.

Wild geese were domesticated and bred on farms at an early period with varied success. No change in appearance or color has been wrought by man; their appearance and habits are the same. The writer has had many years of experience in breeding and handling these wild fowls, and finds their wild instincts always foremost. Birds reared with our domestic geese will rise and fly if an opportunity presents itself. The only means of controlling them is to remove the last joint of one wing when the goslings are only a few days old so that they cannot fly.

The standard weight of Wild geese is ten to twelve pounds. They are of medium size, with long arched neck, small, well-elevated head, with black beak and an ever-watchful eye; head black, with a triangular white patch or cheek piece meeting under the throat; neck black, shading to gray at base; the back dark gray, breast light gray, shading to white on under part of the body; wings long, large and powerful, and in color dark gray approaching black. The young are similar in color to the adult, except that they are a little duller in shade and the white cheek piece is marked with black. This disappears at maturity, however, and at one year old the young have precisely the same color as the adults.

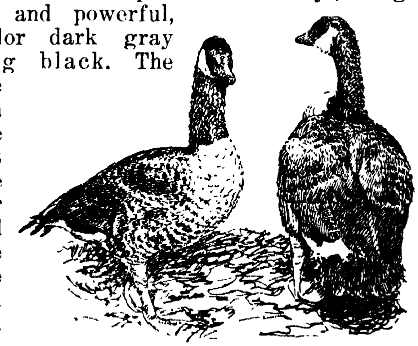

Fig. 589. Wild or Canadian geese.

Egyptian (*Chenalopex Ægypticus*). (Fig. 590.)

This variety is entirely different from all other standard or domestic varieties of the goose family. It produces only a small number of eggs and is of little value except for ornamental purposes. Its native home is north and central Africa and the shores of the Mediterranean sea. Historians and naturalists allude to the Egyptian as the oldest and most ancient variety of pure-bred geese. At present it is common over southern Europe and occasionally fine specimens can be found in America. It is the native wild goose of the River Nile country. Because of its small size and peculiar

shape, some naturalists place the Egyptian as much in the duck family as in the goose family. It is the smallest standard or domesticated variety, weighing six to ten pounds, the latter weight being the extreme for mature males.

The male and female are alike both in shape and in color, and it is frequently difficult to distinguish the sexes under ordinary circumstances. It is necessary to "wing" both mature and young birds to prevent their flying away. They care little for other domestic varieties of geese and ducks, and prefer to remain by themselves near the pond or marsh. They are sought principally for parks and public exhibitions. While small in stature, the old males are very pugnacious and quarrelsome with all other aquatic fowls, and especially with males of their own species. With better domestication this troublesome characteristic will no doubt be overcome to a great extent.

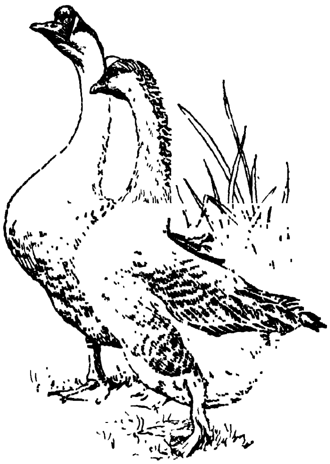
Fig. 590. Brown Chinese Geese.

In color, the Egyptian goose is the most varied and gaudy of the goose tribe. The head is small and rather long, a little inclined to duck shape; the bill of medium length and rather flat, and in color purple or shaded red; the eyes orange color, prominent and bold; the neck medium length, small, gray and black in color; the back narrow and arched or egg-shaped from base of neck to tail, color grayish black; the breast round and deep, with a chestnut-colored middle, the lower part dark gray. The same chestnut color extends around the eye, covering the side of the head in both male and female. The wings are large and powerful, and underneath the wing joints are provided with a strong, horny spur five-eighths of an inch long, being entirely different in this respect from other varieties of geese. The surface of the wing is white, with a narrow black stripe or bar of clear metallic luster, wing flights clear black, tail medium size and metallic black, thighs pale buff or gray, feet reddish yellow. Altogether the Egyptian is a most interesting variety and worthy of more than passing attention. It breeds well in confinement under favorable conditions, the goose producing six to eight eggs, making a nest and hatching her young. If it has access to a pond or waterway, it requires very little attention or grain food.

Sebastapool.

The Sebastapool goose is a native of eastern Europe and western Asia and the Black sea, and was imported to America as early as 1860. It is a pure-bred, but not a standard variety, pure white in color, of medium size, mature specimens weighing ten to eleven pounds each. The peculiarity of this most novel variety is its plumage, the back and wing surface feathers being long, inclining forward and downward, without shaft and curling as though fanned by the breezes. The irregular ribbon-like plumage attracts attention wherever exhibited. Very few good specimens are to be found in America.

Wild geese of North America.

Brant found some twenty distinct types or varieties of wild geese in North America. We here mention only a few of the more prominent. All North American varieties are birds of rapid and powerful flight, non-divers except when wounded, and nest on the ground in high latitude; but nests have occasionally been found in the forks of a low tree a few feet from the ground.

The wild Blue goose (*Chen cærulescens*) is a distinct variety found in the interior in the Mississippi valley and north to the Hudson bay country. It is rarely seen on the Pacific or Atlantic coasts. It winters along the gulf of Mexico and nests in the interior of Labrador. It is somewhat smaller than the Canadian Wild goose and much shorter in neck. The head and the upper part of the neck are white, the breast, back and wings brown and blue tinged with gray, the tail brown edged with white, the bill pale pink with a black mark along each mandible, and the shanks and feet bright pink in color.

Large Snow goose (*Chen hyperborea*).—This variety is native from Alaska to Texas and Cuba. It feeds largely on the land from growing vegetables, and returns to the water for resting and drink. The adult specimen is white in color, except the primaries of the flights, which are black, shading to gray at the base. The bill and feet are bright red.

Small Snow goose—The color and general characteristics of the Small Snow goose are the same as those of the Large Snow goose except as to size. It is found from the Mississippi valley to California, and from as far south as Lower California to as far north as Hudson bay.

The Ross goose.—This goose is the same in color as the Snow goose, but very small in size,—in fact, it is the smallest of all wild varieties, mature specimens weighing only about three pounds. It is without doubt the bantam of the wild goose family. It is not numerous. In summer it occupies the country about the Arctic ocean and in winter is found along the Pacific coast and in southern California.

The White-fronted goose (*Anser albifrons*) is of medium size and grayish brown in color. The first short feathers from the beak toward the eye are white bordered by dark brown, and hence the name, White-fronted goose. The bill, legs and feet are pink or red. It inhabits the entire western part of North America from Mexico to the Arctic ocean. It feeds almost entirely on grass and other vegetable matter, and occupies the water only at night

and during the molting period. The nest is made on the low ground near fresh-water marshes and small lakes. The goose produces five to seven eggs of a cream color.

The *Hutchins*, *Western*, and *Cackling* varieties of wild geese are all similar in characteristics and color to the Canadian Wild goose except in size, and are less numerous.

The Bernacle goose (*Bernicla cucopsis*) is said to be a straggler from Europe, where it is common. It is very scarce in America, and is found only along the Atlantic coast. It is a small bird about the size of the Brant. The head is white except the top, which is black; the neck, back and wings are white, the under part of the body dull white, ending in clear white at the rear end; the tail, bill and feet are black.

The Emperor goose is a rare variety, found principally about the Bering sea, and said by some writers to be the handsomest of all American varieties. In color, the head and back of the neck are white, the front and sides of the neck are brownish black checked with white, the tail is dark gray at the base and white at the end. The wing and body plumage is of a bluish shade, each feather ending with a band of white and laced by crescent-shaped black markings; the primaries of the wings are black, and the secondaries slaty black laced with white. It nests on the low marshy islands of Alaska, near the water mark.

Black Brant. (*Branta bernicla.*)—This goose is of medium size, nearly black in color except the under rear part of the body. It inhabits nearly all of North America as far east as Greenland, and north to the Arctic ocean. The nest is made on the ground on small islands in fresh water in Franklin bay. The nest usually contains four or five eggs.

Wild varieties of the eastern hemisphere.

Of the wild varieties of Europe, there are three distinct types: the Gray-lag goose, the Pink-footed goose and the Bean goose. The common domestic, or English variety, is no doubt a descendant of the wild Gray-lag.

The wild Gray-lag goose (*Anser cinereus*), alone among wild varieties, will cross with domestic geese and produce fertile progeny. Very few Gray-lags are to be found in Europe except in the Shetland islands and on the coast of Norway. As a variety it has become almost extinct.

The Bean goose (*Anser segetum*) closely resembles the Gray-lag in many respects, but is shorter in beak and has greater length of wings or flight feathers.

Pink-footed goose.—Very little can be said regarding the Pink-footed goose except that it resembles the Gray-lag and Bean varieties in color and general type, and is very difficult to distinguish from them.

The Gambian or Spur-winged goose is a native of the eastern hemisphere, and is very rare in America. The plumage is black and white, the former predominating. The goose is of medium size, erect in carriage, with a knob on the head similar to that in the Chinese variety. The eyes are bright brown, the beak and shanks dull red. Because of its wild nature it is rarely bred in confinement.

The Cereopsis goose is a native of New Holland and is becoming very scarce even in Europe. It is a handsome variety. It is very pugnacious in disposition, and cannot be kept successfully with any other variety of water-fowl.

Judging geese.

For judging geese, the American Standard of Perfection provides a standard weight for each standard variety — adult male, adult female, young male and young female. In competition with others of the same kind, the specimen nearest the required weight, other conditions of color and form being equal, shall be the winner. However, in the large market varieties, such as the Toulouse, the Embden and the African, the writer thinks that, all other conditions being equal, the largest specimen should be the winner.

Literature.

Geo. E. Howard, Ducks and Geese: Standard Varieties and Management, Farmers' Bulletin No. 64, United States Department of Agriculture (1906). [For further references, see page 527.]

Grouse, Domestication of the Ruffed. *Bonasa umbellus. Tetraonidæ.* Figs. 591, 592.

By *C. F. Hodge.*

The possibility of rearing the ruffed grouse, or American partridge, in domestication is now a demonstrated fact. Six birds from a clutch of twelve were thus reared by the writer in 1904, and three were brought to maturity by Arthur Merrill, of the Massachusetts State Hatchery, at Wilkinsonville, in 1906. One pair of the former lot bred successfully in captivity when they were ten months old, and those at the Wilkinsonville Hatchery are apparently breeding normally this season.

Rearing the birds.

The ruffed grouse lays ten to sixteen eggs in a slight depression in the ground, in a brush-pile or at the base of a tree. The clutches are usually completed in Massachusetts by May 1 to 10, and the incubation period is twenty-four days. At any stage of incubation the eggs may be transported by the "hat method" in perfect safety. This method consists in laying a pad of cotton-batting in the crown of a felt hat, placing the eggs on this and then simply wearing the hat with the eggs next to the head. One case is known in which the chicks actually hatched in the hat. The young pip the shell usually a full day before they finally emerge.

The eggs hatch well under Cochin bantam hens (less so, thus far, in incubators), and the young may be allowed to remain undisturbed in the nest one day without feeding. The rule to be followed after this is, feed lightly and often, and keep them hungry: especially, keep them hungry and active. The only exception to this rule is at night, when they must be fed enough to send them to sleep contentedly. After feeding liberally one evening, for

example, one four-days-old chick was found wandering disconsolately about in the dusk. It ate sixty-five full-grown maggots before it crept under the hen. This incidentally illustrates both quantitatively and qualitatively the food of the young chicks, which is, at first, almost wholly small insects and spiders.

Feeding and care.—The best first-feed is supplied by cutting branches of apple, maple, chestnut, and elm, with leaves covered with aphides, and spreading them down before the brood; or the chicks may be allowed to pick the small insects from the grass or from the plants in the garden. If the weather is cold or wet so that they cannot be risked out of the brooder, they may be fed for the first day or two on well-ripened and cleaned maggots, a few at a time; and if these fail, as they do in exceptionally cold seasons, the attendant may give sparingly of pheasants' custard. This is made by beating up a fresh egg with a half cup of fresh milk, and baking or scalding until coagulated. It is well to add a pinch of chick bone-meal to each feeding. The chicks will also need a good supply of grit, and it is well to keep a bunch of fresh chickweed, wood sorrel, shepherd's purse, or wild peppergrass before them from the first. They should, in fact, be encouraged to eat all the bulky, coarse, vegetable matter possible. Grated carrot is excellent during the first weeks. All this vegetable food may be kept constantly before them, as it always is in nature. This rule also applies to all kinds of fruits as they ripen through the season, from strawberries, mulberries and cherries to huckleberries and black cherries, which are a staple food through the summer, and grapes and apples, chestnuts and acorns in the late fall. Throughout the summer, grasshoppers form the staple insect diet. These can generally be secured in any desired quantity by sweeping the mowings with insect nets.

Fig. 591. Ruffed grouse cock about five months old.

In the late summer and fall, leaves of trees and shrubs form a large part of the bird's diet. It is strange that, with all sorts of fruits and grains before them, they will insist on eating leaves and buds; but queer as the taste may seem, there is no disputing it.

The birds winter easily, in fact, winter themselves if supplied with abundance of budding brush, poplar, apple or birch, some grains and seeds, as of kafir, corn, buckwheat, millet, wheat and sunflower, a cabbage head occasionally and apples. We may also add cranberries and wintergreen berries, but these may be an unnecessary extravagance. If provided with a warm shelter with sunny windows, the partridges will spend their days in it wallowing and feeding. They sleep, however, invariably outside, either perched in the brush, preferably a thick mass of spruce, pine or hemlock branches, or in snow burrows that they dig whenever the snow is deep enough.

In the spring the flock must be carefully watched and the cocks must be put each into a separate cage as soon as any signs of fighting appear. The hens may be kept in a cage together, at least until mated, when it will probably be best to give each one a cage or run to herself. When the cocks begin to drum, place the hens with them and they will mate immediately. The hens should then be removed, as it seems to be the rule for a cock to peck a hen to death if confined with her after mating.

Fig. 592. Ruffed grouse strutting.

Difficulties in the way of domesticating ruffed grouse.

It is usually stated that the ruffed grouse is untamable, and this is given as the reason why the species has not been successfully domesticated. The experience of the past five years has entirely disproved this theory. It has also been asserted that it is too nervous to submit to the necessary confinement of domesticated fowls. This, too, is disproved. If actually hatched under domestic conditions, the birds are quite as tame as barnyard fowls, and remain so; and they are quiet, show no abnormal restlessness and appear quite as contented as ordinary fowls. The real reason why the American partridge—and this probably applies to the bobwhite and other native grouse—has not been brought under domestication is, that the species succumbs to a disease, generally present in the domestic fowl. The disease is caused by a parasite which produces the "black-head" or "favus" of the turkey. This disease has made the rearing of turkeys over wide areas impossible on ground contaminated by the domestic fowl, and will render the rearing of grouse with fowls impossible in the same regions. Turkeys or grouse may be reared in these localities if the chicks are kept in brooders, off the contaminated ground, for the first two or three weeks, and are then taken to the woods where the ground is uncontaminated by fowls. It is possible that a resistant strain may be developed, but this will take time. Cochin bantams may also be reared in incubators and brooders so as to be entirely free from the parasite, and then, on uncontaminated ground, they might be used successfully to rear grouse or quail. However, experiments have only recently been projected along this line on the theory, which is probably safe, that the parasites are not transmitted through the egg.

Another disease, known as the grouse disease, has recently been distributed among the breeding

stations and has presented a new and serious difficulty. This is bacterial in origin, due to *B. Scoticus*. All precautions should be taken against spreading or harboring this germ wherever the rearing of grouse is to be attempted.

Literature.

Sylvester D. Judd, The Grouse and Wild Turkeys of the United States and Their Economic Value, Bulletin No. 24, Bureau of Biological Survey, United States Department of Agriculture (1905); C. F. Hodge, Domesticating the Ruffed Grouse, Country Life in America, April, 1906.

Guinea-fowl. *Numida meleagris. Numididæ.* Fig. 593.

By *T. F. McGrew.*

The guinea-fowls belong to the gallinaceous division of birds. They were found originally in Africa, and are said to have been reared centuries ago by the Greeks and Romans as table poultry. They were brought into the West Indies by immigrants, and from there were well distributed over the entire American continent. They are of a semi-wild nature ; even when domesticated they almost refuse to make their nests other than in hiding, where they deposit, hatch and rear their young.

Varieties.

The Pearl guinea, the most common variety of the family, has been so named from the fact that its plumage is dotted with white spots, the body color being purplish gray. The spots are of a pearl shape and color. The head is bare of plumage, with a bony protuberance on the crown that is often called a helmet, sometimes spoken of as the comb of the guinea-fowl. It has small wattles, bright-colored eyes, and alert, quick carriage. It is difficult to distinguish the male from the female. The male has a tendency to travel on tiptoe as he moves about, and his cry or call is a little louder and harsher than that of the female, and of greater duration. This variety is most valued because it is the largest and most vigorous.

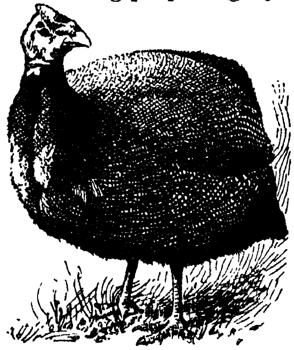

Fig. 593. Common guinea-fowl.

Vulturine guinea (*Acryllium vulturinum*).—The so-called Vulturine guinea-fowl is a most beautiful wild bird. It is not a true guinea-fowl, but bears a close resemblance. It is seldom produced in captivity. A few specimens have been known to deposit their eggs when confined in runways, but there is no record of their having reared any young in captivity. The Vulturine has a bare head, the neck, which is of a reddish color, is ornamented with flowing feathers of considerable length, which have a broad stripe of white down the center. The feathers of the back are of similar form, dotted with white spots; other parts of the body are blackish brown, ornamented with numerous spots. The breast and sides of the abdomen are of a beautiful metallic blue, shaded with black. The whole plumage is emblazoned with rich, metallic blue, and some parts are shaded with a dull pink.

The wild crested variety is said to have come from Eastern and Central Africa. It has a black crest instead of the bony protrusion of the other varieties. It has also blue markings instead of white; the neck and wattles are of a bluish cast.

The white variety is thought to have originated from albino sports of the Pearl guinea. This, like the broken-colored varieties, is not natural to the breed, but has resulted from sports. Attention has been given the breeding of the white guinea-fowl within recent years, and much has been added to its size, vigor and attractive qualities.

Raising.

Guineas prefer to mate in pairs, but they do not object to mating with three to five females, or in trios when there are more females than males. They lay small eggs, about two-thirds the size of an ordinary hen's egg. The shell is very strong, of a dark color, and spotted throughout. The eggs are usually remarkably fertile. The fowls have been known to make a deep, tapering nest, in which they would lay twenty-seven to thirty eggs, and hatch the greater part of them in four weeks' time. They like to conceal their nest, and will leave it if they see a person near it. It is said that they are able to detect whether the hand has touched the nest in their absence, and if so they will desert it. If eggs are removed with a stick or spoon, either some should be left or others substituted, so as to leave about five in the nest. When first hatched, the keets (young guineas) need to be fed frequently on finely broken particles of grains or seeds. As they grow older, whole wheat and cracked corn seem to be the best food to furnish them. Barley, oats, buckwheat and millet are also recommended. Guinea-fowls generally feed with the chickens, and thrive on the same foods. They should not be over-fattened for market. A fattening period of one to two weeks is ordinarily enough.

Generally, only a few guinea-fowls are bred on a farm. A few attempts have been made to breed them in considerable numbers, the most successful of which were in Ohio, where a guinea broiler farm of modest pretensions has been conducted for several years. The place most suited to the guinea-fowl is the farm, from the fact that it prefers to live in a partially wild state. It is a wonderful forager, and will almost support itself and young during the entire summer months, if there is a good supply of bugs, worms and seeds over the range. It likes to wander over great distances. It retains in captivity its ability to fly almost as well as though it had never been domesticated.

Guineas prosper remarkably well in the South. It is not unusual to see large numbers of them in flocks during the early fall. They seem to cluster in groups at that time, as do the blackbirds. They

take up their abode at night in the trees near to buildings, or feed-lots, where they can gain a food supply from waste grain and other materials.

Improvement.

If proper attention were given to the mating of guinea-fowls to improve their size and laying qualities, they could be developed into a most profitable kind of poultry. They are prolific egg-producers during the spring. Attention should be given to the culling out of inferior specimens and the smaller sized hens, breeding for improvement being done only by the best specimens.

Uses.

The eggs are more valued for cooking than for table use. The guinea-fowl is very wholesome meat, and the broiler is considered one of the delicacies in poultry. Both old and young are used as substitutes for game birds. Guineas are very watchful, and sound the alarm if the poultry-yard is molested.

Literature.

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Pheasants and Related Fowls. *Phasianidæ.* Figs. 594–597.

By *Homer Davenport.*

The pheasant family includes within its scope, the turkey (which see), peafowl and jungle-fowl, aside from what are called pheasants in common speech. The guinea-fowl is nearly related. The members of this group are valued chiefly for their feathers and for ornamental purposes. But the economic value of pheasants to the farmer is scarcely sufficiently appreciated. The birds destroy enormous numbers of injurious insects. Upwards of twelve hundred wire-worms have been taken out of the crop of a pheasant; if this number were consumed at a single meal, the total destroyed must be almost incredible. There is no doubt that insects are preferred to grain, while the roots of various weeds are apparently relished. One pheasant, shot at the close of the shooting season, had in its crop 726 wire-worms, one acorn, one snail, nine berries and three grains of wheat. Yet it must be noted that in captivity grain forms the favorite food, and a field of standing beans, as is well known, will draw pheasants for miles. Pheasants are occasionally carnivorous.

Description.

The pheasants, typified by the genus Phasianus, are readily distinguished by their long, straight, pointed tail feathers, eighteen in number, the middle pair being much the longest, and the tail tapering to a point. These tail feathers attain their maximum development in the Reeve's pheasant, reaching, in that species, to a length exceeding five or six feet. The writer once exhibited a Reeve's pheasant that measured six feet and one inch from the first bar on his tail to the tip. The pheasants are all destitute of feathered crests or fleshy combs, but are furnished with small tufts of feathers behind the eyes. In their native state they are essentially forest birds, frequenting the margins of woods, coming into the open tracts in search of food, and retreating into the thick underwood at the slightest cause for alarm.

The flight of the pheasant is strong, and is performed by rapid and frequent beats of the wings, the tail at the same time being expanded. The wings, considered with reference to the size and weight of the bird, are short and small (with the exception of those of the Argus pheasant), the secondary quills being nearly as long as the primary; they are very rounded in form. The third and fourth primary feathers are the longest. The wings are not adapted to very prolonged flight, although the denizens of the wilder districts in the country fly with a speed and cover distances that are unknown to the over-fattened birds in our preserves. Long flights, however, are not altogether beyond the powers of pheasants. The comparatively small size of the wings necessitates their being moved with great force and velocity, and consequently the moving powers or muscles of the breast are very large and well developed, taking their origin from the deep keel on the breast-bone.

Breeding notes.

As the breeding season approaches, the crow of the male of the common pheasant (Torquatus) and others of like species, may be heard distinctly, resembling the imperfect attempt of a young fowl. It is followed, and not preceded, as in the game cock, by the clapping of the wings; the pheasant and the domestic cock invariably reverse the order of succession of these two actions. Like the domestic fowl, pheasants will also answer any loud noise, occurring either by day or by night. The display of the plumage by the males during courtship varies in almost every species of gallinaceous birds. Pheasants seem to possess no other mode of display than the lateral or one-sided method. In this, the males disport themselves so as to exhibit to the females a greater number of their beautiful feathers than could otherwise be seen at one view.

In a state of nature there is little doubt that the pheasant is polygamous. The males are armed with sharp spurs, with which they fight, the stronger driving away the weaker, and the most vigorous propagate their kind. This is true with the single exception of the Argus pheasant, most beautiful of all in plumage. The nest of the female is usually a simple hollow scraped in the ground. The eggs that are laid vary largely according to the species. The Torquatus pheasant in its wild state in Oregon generally lays fifteen to nineteen eggs in its nest before sitting, whereas the Peacock pheasant lays but two. As a rule, the male pheasant takes no heed of the eggs laid by the female, but he seems to have great regard for the offspring, and in some instances will defend them to his death. Pheasants usually nest to lay in the latter part of April, the date varying somewhat

with the season and the latitude. The Silver pheasant usually is the first to lay, and the Impeyan, or Monaul pheasant, the last.

DESCRIPTIVE NOTES

Peafowl or peacock.

The peafowl or peacock represents the genus Pavo of the sub-family Pavoninæ, of the pheasant family (Phasianidæ). Of the peafowls there are two distinct species, both apparently coming from India or the neighbouring countries. The common or grey-winged peafowl is the one generally seen throughout the civilized world at the present time. The green or Java peafowl is found in Java and Burmah, and is a distinctly different species from the others. The black-winged peafowl, which is probably a variety, is said to have originated in Japan. Two other varieties are known, the white and the pied.

The Green or Java (*Pavo muticus*).—This bird is a native of Chittagong, in the eastern part of India, through Burma to Java. Perhaps, if feather for feather were contrasted with other birds, this would rank as the most beautiful of all known birds, possessing in its majestic plumage every color of the rainbow, every tint and tone in the prismatic scale. Its neck feathers, less rich in hue than the blue of its rival, have a particularly beautiful effect, as if made of metal; and the almost equal beauty of the hen places her far above the dowdy mate of the common peacock. It is much larger than other species, breeds readily in any climate, and is a handsome ornament to any country home. Most important, perhaps, is the fact that it does not utter that shrill, ear-splitting scream that makes the common peacock a rather unpopular bird.

The Common peafowl (*Pavo cristatus*).—Little need be said of this beautiful bird. It is found all over the world, breeds readily in any climate, and is very tame.

The Japanned or Black-winged (*Pavo nigripennis*).—This peafowl, erroneously called the Japanese peacock, is attributed to Japan. It is among the really beautiful types of the peacocks. The male bird is the darkest of all the peacocks, and, strangely enough, the female is the lightest, being almost white. It is hardy, and can be reared in any climate where peacocks are bred.

White and pied peacocks.—Of the peacock family, there are two other varieties, the white and the pied. Both have attained wide popularity owing to their delicate beauty. The white peacock has reached its highest state of cultivation in India, and for a time, at least, was supposed to have been worshipped as a sacred bird by some of the people of India. The pied peafowl is one of the most attractive, and, possibly, is the result of the crossing of one or two species of the peacocks.

Pheasant.

The Argus (*Argusianus argus*) is classed by some naturalists in the peacock group. It is a native of Malacca, Siam and northwestern Borneo, frequenting the jungles. It is undoubtedly one of the most magnificent of the pheasant family. It is so extremely shy in its habits that there are few instances of its being shot, even by native hunters. It measures five feet in length, the tail being three feet and over in length. The prevailing color is ochreous red or brown, without brilliant relief. There is a pronounced harmony in the distribution of the tints, there being such a profusion of small spots, sometimes lighter and sometimes darker than the ground, that they assume, apparently at will, the tones of their environment. Its broad secondary feathers are covered in their entire length by a row of eye-like spots imitating half globes, and nothing from the brush of nature is more artistic or more beautiful. It is from these spots that the Argus takes its name. The naked skin of the face and neck is bright blue, contrasting well with the bronze hue of the plumage. The female possesses none of the markings of beauty characteristic in the male, and is but twenty-six inches in length. Although the Argus is remarkably wild in its native state, it becomes unusually tame in captivity, returning to its aviary at night after enjoying full liberty during the day.

The Impeyan (*Lophophorus impeyanus*).—The Monaul or Impeyan pheasant is one of the most gorgeous birds. The wonderful metallic brilliancy of the cock's plumage, gleaming in purple and gold, baffles description. It inhabits the high ranges of the Himalayas, seldom coming below an elevation of 6,000 feet. It is tough and hardy, and digs with its strong bill for roots and worms. It becomes tame enough in captivity to be allowed to run loose in the barnyard. Owing to its unsurpassed beauty, combined with its rugged nature, few species of pheasants are more attractive than the Impeyan.

The Tragopan (*Tragopan*, or *Ceriornis*, spp).—There are five species of the Tragopan family: Crimson, Temminck's, Cabot's, Horned and Slater's. They are easily secured, with the exception of the last named. In the display of his plumage, the Tragopan cock is more interesting than any other of the pheasant family, mainly for the reason that under the proper conditions the male bird elevates a tiny pair of bluish fleshy horns on either side of the ears on top of the head. This gives the bird a satanic expression, bewildering and unparalleled in the bird family. Under the throat he drops down a fleshy bib. Then, with the tail scraping on the ground, and his wings down like those of a turkey, he struts in a semi-circle. The Tragopan is very tender. It is bred readily in captivity.

Manchurian or Eared pheasant (*Crossoptilon Mantchuricum*).—This bird is a native of Pekin. It is not of gorgeous plumage, although a majestic bird. It is hardy, with a glossy hair-like plumage of the richest bronze, shading to a delicate purple on the lower feathers of the tail; the upper tail feathers are peculiarly curved up and down. Under the throat it has a white muff running up back of the head, giving the appearance of a person with a sore throat having a handkerchief tied round it. It is the only member of the pheasant family in which the plumage of the male and the female are

exactly the same. There are several species of the Manchurian or Eared pheasant.

Peacock pheasant (*Polyplectron chinquis*).—This strange pheasant is one of the most peculiar, and, at the same time, one of the most fascinating. It inhabits the deep gullies of the Asiatic mountains. It is small and quick of flight. The hen lays but two eggs before sitting. On the male bird, at the end of each gray feather, is a metallic purple or greenish spot, whence the name Peacock pheasant. Unlike other pheasants, the legs of the male are adorned with many spurs, and the writer has had males with as many as five spurs on one leg. The cock bird whistles so plainly that he has been known to call the dogs.

Fig. 594. Common peacock.

Reeve's pheasant (*Phasianus Reevesi*).—This is the largest of the true pheasant family, and is one of the grandest. It is a very hardy bird, and is the swiftest of all the pheasant family on the wing. Its tail measures more than six feet. It inhabits the mountains of China.

Sœmmerring's pheasant (*Phasianus Sœmmerringi*).—This bird, also called the Copper pheasant, is a native of Japan. It is one of the handsomest of the true pheasants. The males are very pugnacious and sometimes battle to death with others of the same race. It is rather rare, both in aviaries and in the wild state, mainly, perhaps, because of the number killed for the feathers. The tail of this pheasant is frequently seen dangling from women's hats.

Elliot's pheasant (*Phasianus Ellioti*).—This species, named after Prof. D. G. Elliot, of Chicago, is one of the very fine species of the true pheasant. It is very hardy. It inhabits the mountains near Ningpo, China. In aviaries, the hens have been known to hatch and rear their young without a single loss.

The Mongolian (*Phasianus Mongolicus*), Fig. 595.—The Mongolian pheasant is a native of Asia. It comes from the valley of Syr-Daryr, and as far east as Lake Saisan, in the valley of the Black Irtish. In England, it has been crossed on the common English pheasant, and the hybrid has produced a remarkable game bird. Only one pair is known to have reached America alive, and they were so wild that no young were ever reared from them. This pheasant is commonly mistaken for the Chinese ring-necked pheasant (*P. torquatus*), but the Mongolian is a much larger and more beautiful bird.

Versicolor or Green Japanese (*Phasianus versicolor*).—This beautiful small bird inhabits nearly all parts of Japan. Owing to its use to the milliner, it is perhaps better known than any other variety, although the pure specimens are very rare in America.

Ring-neck (*Phasianus torquatus*).—This handsome game bird, called also the China torquatus, is the common pheasant of China. It is frequently miscalled the Mongolian pheasant. In 1884, a few specimens were liberated in Oregon, and today there are probably more in Oregon than in China. Throughout the Willamette valley, in Oregon, it can be found in great numbers. It is far superior to the English pheasant as a game bird, as it is much wilder and swifter on the wing. It is exceedingly hardy.

English (*Phasianus colchicus*).—The common Black-necked English pheasant was a native of Central Asia, and is supposed to have been brought to England by the Romans. Owing to the infusion of Torquatus blood, it is almost impossible at the present time to find the old common English pheasant in its purity.

Cheer (*Catreus Wallichi*).—This rather large pheasant inhabits the mountains of Asia. It is very hardy and relishes roots, but seldom eats grass. Its plumage is a sort of monotonous check of gray. The male and the female much resemble each other.

Siamese Fireback (*Lophura prœlata*).—There are several species of the Fireback pheasant, the most common of which is the Siamese, which inhabits parts of Siam. It is a beautiful, small, gray bird, with a tassel on the head, and an oddly hooked black tail. The male displays the beauty of his plumage by lowering his wings, so that his bright yellow and red back are exposed to view.

Bornean Fireback (*Lophura nobilis*).—This species is, perhaps, the next most familiar of the Firebacks. It comes from Lower Borneo, and is very similar to the Siamese, except that the color of the flesh of the face, instead of being bright red, is deep blue. It is also a slightly larger bird.

Villiot's Fireback (*Lophura rufa*).—This is possibly a more beautiful bird, owing to its brilliant blues, than the other species of Fireback. It is a native of Siam, and is rarely seen in collections.

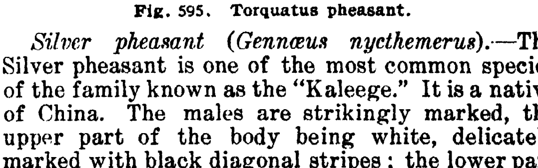

Fig. 595. Torquatus pheasant.

Silver pheasant (*Gennœus nycthemerus*).—The Silver pheasant is one of the most common species of the family known as the "Kaleege." It is a native of China. The males are strikingly marked, the upper part of the body being white, delicately marked with black diagonal stripes; the lower part of the body is jet-black.

Lineated pheasant (*Gennœus lineatus*).—This species of pheasant inhabits Burmese countries. It is very beautiful and graceful, quick on the wing and very hardy.

Anderson's Kaleege (*Gennœus Andersoni*).—This type is native of the Himalayas. It is as handsome as any of the Kaleege, and as hardy. It is slightly lighter than the Lineated and darker than the Silver pheasants.

The Melanotus or Black-backed Kaleege (*Gennœus Muthura*).—This pheasant inhabits Sikhim, Napal. It is characteristic of the male to churn the air with his wings until he causes vibrations that are truly remarkable in their effect.

Swinhoe's pheasant (*Gennœus Swinhoii*). — This bird inhabits Formosa. Its glossy feathers have the appearance of blue velvet. The female of this species is unlike most of the other dull brown hens, as her feathers resemble exquisite tapestry, so delicate and finely are they marked.

The Lady Amherst (*Chrysolophus Amherstiæ*), Fig. 596. — This bird, as an ornament for the aviary, cannot be surpassed. It is more striking, even, than its relative, the Golden pheasant. It is found in China, bordering on Eastern Tibet, and is called by the natives the Flower pheasant. The species derived its name from the fact that Lady Amherst, of England, is considered to have received the first pair that ever came to Europe.

The Golden (*Chrysolophus pictus*).—This pheasant, perhaps, needs no description. It is to be seen in every zoölogical garden. It inhabits the mountains of Western and Central China. The male bird is much prized for his gaudy red and golden feathers.

Black-throated Golden.—The habitat of this beautiful pheasant is not known. It varies slightly from the common species. The hens are darker and handsomer, and the chicks when small have white throats.

Jungle-fowl.

The jungle-fowl are of the genus Gallus, of the pheasant family. They are native of southeastern Asia, India, Sumatra, Java and Borneo. Four species are known, and all bear striking resemblance to the common domestic fowls, being rather over bantam size. They possess the carriage of the

Fig. 596. Lady Amherst pheasant.

pheasant, but the tail is vaulted and carried rather low. The cocks have single, small-sized combs and long sharp spurs.

The Red (*Gallus ferrugineus*), Fig. 597. — This resembles the old Red-black Game of the English fighting type, and is frequently mistaken for small specimens of that breed. This gives rise, with justice, to the conclusion that it is the direct ancestor of all our domestic breeds of fowls. It is easily tamed. The hen lays nine eggs. The cocks are very pugnacious and will battle to the death. The Red jungle-fowl is found in India and most of the islands south as far as the Philippines.

The Gray or Sonnerati (*Gallus sonnerati*).—Although rather somber, this species possesses a peculiar hackle feather, tipped with a wax-like substance that resembles burnished gold. It is less hardy than the Red jungle-fowl, particuiarly in captivity. The Gray jungle-fowl is one of the rarest of the pheasant family, and it is indeed unusual to find one in any of the great "zoos" of the world. It inhabits lower India. The cock's cry resembles a scream more than a cry. It is impossible to domesticate this jungle-fowl.

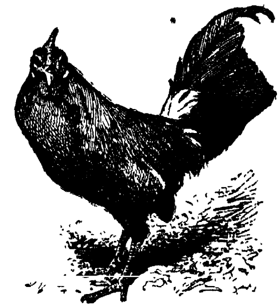

Fig. 597. Red jungle-fowl (*Gallus ferrugineus* or *bankiva*.)

The Green or Java (*Gallus varius*).—This is the most distinct of all the species. The cock's comb is plain edged, and not serrated. The face is very naked, and instead of wattles he has a dewlap that expands and contracts like that of a turkey, the face and dewlap changing color when the latter is contracted. Under this condition the bird actually blushes a bright red. The neck, instead of being composed of hackles, is made up of green scale-like feathers that extend to the upper part of the back. The general plumage is a metallic-purple and golden-green. It is the rarest of all the jungle-fowls. Although the writer has bred this species in captivity, he has failed up to the present to rear any mature birds.

The Ceylon (*Gallus Lafayettii*).—This is found on Ceylon, and is seldom met with in captivity. It is not, in any particular, so beautiful as the species above described. The peculiarity of the cock is the yellow center to his comb, and the peculiar note that he issues in his cry, which, at a distance, sounds like some one calling "George Joyce."

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Pigeons and Squabs. *Columba*, spp. *Columbidæ*. Fig. 598.

By *Thomas Wright*.

The raising of pigeons for fancy has long received attention, but it is only comparatively recently that the raising of squabs for meat purposes has assumed commercial importance. Fancy or "toy" pigeons are generally kept for amusement, and are valued rather for their ornamentation than for their usefulness. [See *Pets*.] Most of them are too small to be classed as utility birds, although occasionally a few grow to good size, and

because of imperfect plumage are killed and dressed for the table. The following varieties, among a great many others, are raised for fancy: Tumbler, Owl, Turbit, Jacobin, Barb, Archangel, Fantail, English Carrier, Nun, Swallow.

The utility or squab-breeding pigeons are receiving more attention today, perhaps, than the toy pigeons.* The breeder who grows squabs for the market not only has the pleasure of handling the pigeons, but gets a reward for his efforts in addition.

Choice of pigeons for squab-raising.

Practical men differ in their opinions as to the best variety of pigeons for squab-raising purposes, just as there are advocates of certain breeds of dairy or beef cattle. By some breeders the Homer pigeon is held to be the best, and many of the squab plants in America raise only Homer pigeons. The writer, among others, has had best results from a bird that combines the qualities of the Runt (English), Mondaines (Swiss and French), and typical Florentine Amalgamated, infused with the Homer. This pigeon produces a large, heavy squab for the same outlay as the Homer, and is equally prolific.

In crossing for utility, the cock should always be the largest bird and should be young. One should never breed a bird that may often be seen with the wings drooped, as it is direct evidence of poor health or lack of constitution. The front of the legs and the beak should be a light color, as dark legs and beak denote dark meat. A black bird with a bright red leg is more desirable than a white bird with a dark leg or beak. The male should exhibit a good disposition; the bird that does much cooing and promenading is likely to be a good breeder. A bird with an apparent sullen, phlegmatic disposition should not be used. The plumage should not be ruffled in any way, but the feathers should be close to the body. Any other condition of the plumage is unnatural in a perfectly healthy specimen. One should not use a bird for breeding that is in any way related to its mate or that is bred from blood relations. Inbreeding is frequently indulged when type alone is required, but it is permissible only under certain conditions. Market specimens need a vigorous, hardy constitution, and this depends much on the union.

Feeding and care.

In the matter of feeding, variety is essential. A good ration consists of equal parts of whole corn, cracked corn, red or amber wheat, Canada field-peas and kafir. Hemp seed, millet and rape may be fed occasionally at the rate of about one-tenth the quantity of other ingredients. Two kinds of green feed that may be fed safely are lettuce and plantain, and it is well to supply them in season. The drinking-water should be placed inside the pens, preferably in a galvanized fountain. A bath-pan, eighteen inches across and four inches deep, should be placed in the aviary outside, and should be accessible every day, except in the severe weather of winter, when it should be placed inside, twice each week. A box containing grit and oyster shells should be on the floor of the pen. A piece of mineral rock salt, similar to that used for cattle, should be always before the birds. Table salt, which is sometimes recommended, is likely to be used too freely for health and may better not be used.

Housing.

A house for pigeons should be entirely free from dampness and should be set up on posts at least two feet above the ground. Any building that is tight and dry may easily be converted into a pigeon house. A southern exposure is preferable. About one-third of the front should be of glass, so as not to admit of any draft. Pigeons are hardy and not very susceptible to disease, and owing to the fact that the blood is about 50° warmer than that of man, they can withstand rather severe weather without evil results. A warm house that is damp will promote disease very quickly. Three

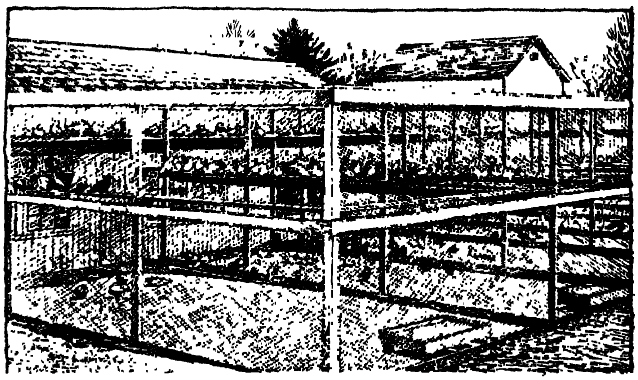

Fig. 598. A well-designed pigeon "fly."

square feet of floor space in the pen to every pair of breeding birds is about right. Perches may or may not be used in the lofts. If the birds are properly working, while one of the pair is sitting on the nest at night, its mate is roosting on the front of it. If roosts are desired they may be made by nailing a piece of scantling seven inches long to the end of a piece six inches long, each piece being five inches wide. When nailed they form the letter V. These pieces are turned up-side-down, and may be nailed to a strip the height of the pen, seven or eight inches apart. On these the birds may roost, one above another, without fouling one another. The droppings are easily gathered, and are always in demand by leather manufacturers, who pay about sixty cents per bushel, by florists and by gardeners. The use of earthern nest-pans, or "nappies" as they are more generally known, is a matter of dispute, and many large commercial plants have abandoned their use. The writer has had good success by using nest-pans nine or ten inches across and four inches deep, and has not been troubled with the squabs getting over the edges, as some growers have reported.

Dressing.

It is impossible to dictate a method of dressing, as so much depends on the wishes of the customer. Some buyers prefer the squabs simply with their necks broken; others prefer to have the feathers removed; still others prefer to have them bled as is done with poultry. If they are picked, they *should be placed in cold water after picking, as it gives them a plump appearance. Picking should be done while the body is still warm. When sold unpicked, they should always be laid on a cool receptacle with the breast down, for the animal heat to* leave the body.

Diseases.

Pigeons are relatively free from disease, and will endure much privation and abuse without bad results. The most common ailments are atrophy or "going-light," megrim and canker.

Atrophy may be treated most easily and successfully by giving five or six drops of cod-liver oil night and morning for four or five days. All tail feathers should be drawn and a good variety of food should be fed, including bread crumbs, which never injure the birds.

Megrim is generally the result of injudicious feeding, and afflicts only over-fat birds. Carbonaceous food, such as corn, fed to excess, causes the blood to congest in the brain. The bird may be seen with the head twisted, and often throwing itself on its back as if in a convulsive state. The remedy is to isolate the patient in a perfectly dark pen, and give it a mild dose of Epsom salts. It is taken from its dark solitude once each day to drink. The bird is held in the hand and the beak inserted in the water. A few days should effect a cure. If this treatment is not successful the bird should be killed.

Canker is a form of diphtheritic roup. Generally, a bird afflicted with it should be killed.

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Quail, Domestication of the Bobwhite or American. *Colinus Virginianus* (sub-family *Odontophorinæ*). *Tetraonidæ.* Figs. 599, 600.

By *C. F. Hodge.*

No bird is more prolific or more easily reared in domestication than the bobwhite; and certainly none makes a more interesting and companionable household pet. The past season a pair nested and laid eighteen eggs in a window-box. Two hens with a cock in a yard at the Massachusetts State Hatchery produced seventy-six eggs. Merrill has found that bobwhite eggs can be hatched successfully in an incubator by allowing them long periods for cooling off, as much as one, and, in hot weather, even two hours a day. They also hatch well under bantam hens, the incubation period being normally twenty-four days.

The young have been reared successfully simply by allowing them to range about the yard with their bantam mother, care being taken that they are well supplied with food for the first few days. This may consist of scalded or fresh "ants' eggs," maggots or pheasants' custard, and, best of all, insects secured by sweeping the grass with an insect net. As with the ruffed grouse, there is danger of disease, especially if the brood is confined with the hen. The safest method is probably to hatch and rear them with the incubator and brooder. Great numbers of eggs from nests broken up in cutting hay and grain might be saved and be made to supply a domesticated strain of the species. The eggs may always be prevented from chilling by wearing them in the crown of a hat, and they may be carried in this way for the better part of a day without injury. The young mature rapidly, being nearly full-grown in about ten weeks from hatching.

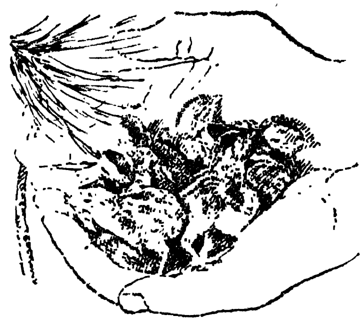

Fig. 599. One-week-old bobwhites, hatched in an incubator.

Uses.

Perhaps no bird is capable of rendering more varied and important service to American agriculture than the bobwhite. The young have been found to eat their weight of insects daily. For the year as a whole, animal matter, mainly insects, forms about 15 per cent of the bird's food; and from May to September this item increases to 31.5 per cent. The great variety and large numbers of the insect pests consumed by the bobwhite make this bird a more effective ally of the farmer than many smaller birds, although the latter may eat a larger percentage of insect food. "Over one hundred potato beetles" and "a tablespoonful of chinch-bugs" are reported from the crop of a single quail; and, if sufficiently numerous, probably similar numbers of nearly one hundred other injurious insects would be eaten, among them the rose beetles, cucumber beetles, squash-bugs, cutworms, cotton-worms, tobacco-worms, clover-weevils, all kinds of grasshoppers and crickets, cabbage caterpillars, many plant-lice and mosquitoes. A bobwhite about three weeks old

Fig. 600. Bobwhite, reared from the egg.

ate 568 (all there were) mosquitoes as fast as it could catch them. The bobwhite eats the Hessian fly larva, pupa and adults, and would consume thousands daily if they were numerous and accessible. A tame bobwhite hen was fed, in addition to all the seeds and grains she wished, 1,280 fully grown rose-slugs in one day.

Weed seeds form over half the bobwhite's yearly food. Among the weeds whose seeds are thus consumed may be mentioned ragweed, pigweed, dock, bindweed, lamb's quarters, sorrel, wild buckwheat, beggar-ticks, witch-grass, crab-grass and barnyard-grass, and perhaps one hundred others. The quantities taken at a meal are enormous: 300 smartweed seeds, 500 red sorrel seeds, 1,000 ragweed seeds, 2,000 ticktrefoil seeds, 5,000 foxtail grass seeds, and 10,000 pigweed seeds. It is little wonder that the farmer is beginning to lose sympathy for the sportsman. And to one who, as a boy, has lived on a birdless farm and seen more chinch-bugs than wheat on the platform of the reaper, it would seem that the farmer's judgment in the matter is correct.

In addition to its value as a destroyer of insect pests and weed seeds, at present prices the bobwhite might be reared to better profit than ordinary poultry. After securing breeding stock, a prime condition of success must be the strict control of natural enemies, chief among which at present in most localities is the cat. If it were not for this arch enemy of bird life, we might soon have the bobwhite at home in every garden in the land. Other comparatively rare and occasional enemies, as snakes, foxes, weasels, minks, skunks, rats and certain hawks and owls, must be dealt with effectively. It is about as easy, and much more interesting, to keep traps always set in likely places as it is to have them lying about idle, as is commonly the case.

Winter care of native quail.

Great numbers of bobwhites are killed during severe winters, especially in sleet storms that may cover their food with ice or imprison whole coveys under the crust. Winter provision should be generally made north of Virginia and Kentucky, by leaving clumps of sumac and wild rose under sheltered banks and on the south sides of groves. An ideal shelter with food combined may be made cheaply by laying down first a pile of weeds, chaff or hay-loft sweepings, placing over this a lot of brush, and then piling over all a rick of coarse weeds cut before the seeds drop, as ragweed, pigweed, sunflower, dock, and the like, leaving the brush exposed on the south side. An arrangement of this sort, placed in a sunny, sheltered exposure, will provide food accessible at all times as well as shelter and protection from hawks. Fresh supplies of screenings or grain may be thrown into the brush as needed during the winter. In this way great numbers of bobwhites might be carried safely through the winters, their numbers rapidly increased up to the natural limits of insect and weed-seed food-supply, and the range of the species extended northward considerably.

Literature.

Sylvester D. Judd, The Bobwhite and Other Quails of the United States in their Economic Relations, Bulletin No. 21, Bureau of Biological Survey, United States Department of Agriculture.

Swan. *Cygninæ.* Fig. 601.

By *Charles McClave.*

Swans are the largest aquatic fowls of the duck family and are found wild in the eastern and the western hemispheres, especially north of the equator.

Black (*Chenopis atrata*).

Australia, isolated south of the equator, has a distinct variety—the Black swan. Like many other so-called black varieties of water-fowl, it is not solid black in plumage. The bill is red, edged with white, the eyes scarlet, the plumage shaded black, edged with gray, and the wing flights slaty white or pure white. The slender, arched neck and curly appearance of plumage over wings and back give it

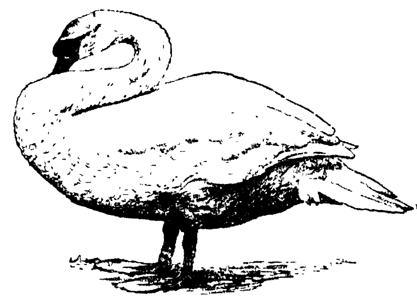

Fig. 601. Swan.

a novel appearance on the water. Though less common than the white swan, this species is a familiar sight in city parks. It is mute.

Mute (*Cygnus olor*).

The Mute swan is a native of Europe, Asia and Africa and is the common domesticated species. The neck is long and slender, the bill red, the eyes brown, the legs and feet brownish gray, and the entire plumage spotless white. The young cygnets for the first year are gray or dusky chestnut in color, but change to white after the first molt. When migrating, it is a very rapid flyer, and with a favorable wind has been known to travel fully one hundred miles an hour.

Polish.

The Polish swan is a large white variety of *C. olor*, found in Europe. It resembles the Mute swan, but the shape of the head is different. The young cygnets hatch white instead of gray or chestnut.

Whistling (*Cygnus musicus*).

The Whistling swan is also a white species, but is somewhat smaller than the foregoing species; the neck is shorter and thicker, and the bill is yellow without protuberance. The naturalist, Olaf, writing of the notes of the Whistling swan, speaks as follows: "When a company of these birds passes

through the air, their song is truly delightful, equal to the notes of a violin." It is a native of northern Europe and is seldom domesticated.

Berwick (*Cygnus Berwicki*).

The Berwick swan is the smallest white variety. The neck is short and very slender. This swan is very shy and wild in disposition and difficult to breed in confinement.

Black-necked (*Stenclus nigricollis*).

The Black-necked swan is native to South America. It is very rare and is seldom seen in public or private parks. It is of good size, with brown eyes, the bill a lead color with a red protuberance at the base, the legs a reddish orange. The plumage is spotless white except on the head and neck, which are clear black with a narrow band of black across the eye. The carriage of the neck is much straighter than that of any other variety of swan.

Trumpeter (*Olor buccinator*).

The Trumpeter swan is a native of the United States and is found principally west of the Mississippi river, but has been seen as far east as Ohio. In former years it bred in Dakota, Montana and Idaho, but at the present time it nests in the country about Hudson bay. The nests are made on small islands and in the marshes and shores of lakes. Five to seven eggs is the usual number produced. Mature birds are pure white, while cygnets are gray or rusty color.

American (*Olor Columbianus*).

The American swan is a pure white variety slightly smaller than the Trumpeter swan. It is a native of the United States and is found principally west of the Mississippi river, although often seen in autumn south to Florida and Maryland. It winters principally in Oregon, Washington and California. In early spring, it migrates north to Alaska and the Yukon country to nest.

Literature.

Stejneger, Proceedings of United States National Museum, Washington (1882); Newton, Dictionary of Birds, Vol. IV, London (1896); Grinnell, American Duck Shooting, New York (1901).

Turkeys. *Meleagris* spp. *Phasianidæ.* Figs. 602–604.

By *T. F. McGrew.*

The present-day turkeys are all grouped in one breed, but represent a number of varieties. The origin of the present domestic turkey was undoubtedly in what is known as the North American turkey, which existed in a wild state over the greater part of North America from the Carolinas well up into Canada. Records show that turkeys were grown or domesticated in England as early as 1541. They were reasonably plentiful in 1573 throughout the agricultural districts of England. Some writers think that the first ones were taken from the West India islands into Europe.

Wild turkeys. (Fig. 602.)

There are three distinct "originals" or wild turkeys, one known as the North American, one the Mexican, and the third, the most delicate of all, the Honduras or Ocellated turkey.

The American "original" or wild turkey, the one that frequented the United States north of Carolina and into Canada, is designated as *Meleagris Americana.* The color of this type is black, shaded with a rich bronze; the breast plumage is very brilliant, tinged with a finish of coppery gold inflection. In the rays of the sun the combination of bronze with the copper and gold glistens like burnished metal. From this wild original, crossed with the domestic Black turkey, which was undoubtedly brought by the early settlers from England, was created the well-known variety of Bronze turkeys.

Fig. 602. Wild turkey.

The Mexican wild turkey (*Meleagris Mexicana*) is of shorter build than the northern turkey. The color is very much the same, but even more brilliant in shading than the North American variety, with the distinction that the tail and other feathers are tipped with white. This species seems to have been the first introduced into Spain and other countries. It is thought that the white markings of this variety had an influence in creating what is known as the Narragansett turkey.

Honduras turkey.—The wild species known as the Honduras turkey (*Meleagris ocellata*), the original breed of Honduras and Central America, is described as the most beautifully colored of all the turkey family. The head and neck of this wild variety are naked. No breast tuft is found thereon. The caruncles of the head and neck differ somewhat from those of other turkeys. The plumage color is described as a beautiful bronze-green, banded with golden bronze-blue and red, with some bands of brilliant black. This variety has never been domesticated successfully. The few that have been kept in confinement have failed to produce of

their kind, and live but a short time out of their own natural realm. They are of what might be termed a low carriage, the breast rather drooping, the tail usually carried in a downward or low position.

Crested turkey.—A distinctive domestic variety is the crested turkey. This has a crest or topknot of feathers on the head, or rather just back of the head on the neck. This type cannot be classed as an original variety.

Common domestic varieties of turkeys.

The domestic varieties of turkeys, as known to this country, are the Bronze (Fig. 603), Narraganset, Buff, Slate, White (Fig. 604) and Black. The Bronze, as originated in the United States by crossing the wild variety with the Black turkey, known in England as the Norfolk. It is the largest, hardiest and most admired of all varieties of turkeys for the market. The Narragansett turkey undoubtedly had somewhat of the same original blood as the bronze, influenced, perhaps, by a cross of the variety from Mexico, which gave a mixture of white in the bronze and black plumage of this variety. It is second in size only to the Bronze, and has been most favorably considered in many parts of New England. The Buff turkey should have true buff plumage throughout. As usually seen, the feathers are of a reddish buff, the wing flights, and at times other feathers of the wing, being white. The Bourbon Red, which is undoubtedly a kindred variety of the Buff, that originated in Kentucky, perhaps, is of deep reddish buff in plumage, and somewhat larger than the Buff variety. It is thought to have been created through a mixture of the wild and the Buff varieties. The Slate turkey might be called a blue variety, the plumage color being of a bluish, slaty shade. The White variety is pure white in plumage throughout, and has pinkish white shanks. The Black variety is pure black throughout the entire plumage. As we now see it, it has undoubtedly been crossed with the Bronze variety to improve its size, and this cross has illuminated the plumage somewhat with coppery shading.

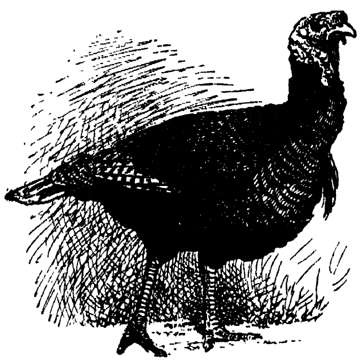

Fig. 603. Bronze turkey.

Turkey-raising.

Considerable attention has been given to the raising of turkeys for market throughout the world. The early tendency to neglect the constitutional requirements and permit constant inbreeding without the intermingling of new blood reduced the vitality and permitted a disease to creep in, known as black-head, which can be obliterated through care in selecting the most vigorous specimens and introducing them as new blood into the flocks.

Turkeys seem to adapt themselves to diverse climatic conditions. They do equally well far north into Canada and south into Texas. The climate both of New England and of California seems fitted for the growing of large numbers of them for market purposes. Locality does not seem to influence their cultivation, provided the parent is strong and healthy and the young are protected from the cold, damp and insect vermin, all of which may be considered most direful enemies of young turkeys. Being of a rather semi-wild nature, they do best when permitted to have their freedom and range with their young over an extended area. Where the natural food on the range is unbounded, they prosper best.

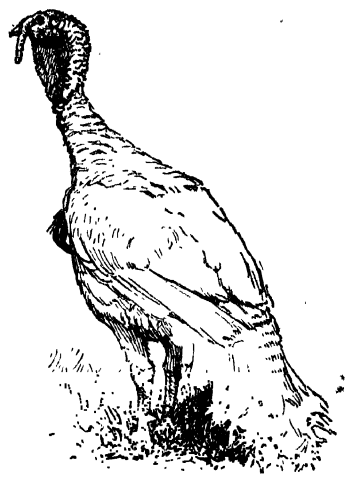

Fig. 604. White Holland turkey.

These fowls do not seem to do so well in confinement as other poultry, being more like the guinea-fowl. They become nervous and restless when confined in limited quarters. A few of them may be handled successfully in enclosures, as are poultry. Under such conditions they will not grow so large nor prosper so well as they will in freedom. The turkey hen lays thirty-five to forty eggs in a season. It takes twenty-eight days for the eggs to hatch. The young turkeys feed themselves as soon as they come from the nest. "Little and often" is the rule for feeding the young turkey for the first few days after coming from the shell. [See article on *Feeding Poultry.*]

Turkeys for breeding purposes should be strong, vigorous, healthy, well matured and not akin. Constitutional vigor is of first importance in the male or tom, as it is called. A medium-sized male with good fair-sized females of strong constitutional vigor and mature age will give best results. The best rule for mating is to have four or five females to one male, although greater numbers of females have been used with good results.

Literature.

T. F. McGrew, Turkeys; Standard Varieties and Management, Farmers' Bulletin No. 200, United States Department of Agriculture (1904); J. F. Crangle and others, Turkey Culture; Herbert Myrick, Turkeys: How to Grow Them; Turkeys: Their Care and Management, Reliable Poultry Journal, Quincy, Ill. [For further references, see page 527.]

REINDEER. *Rangifer tarandus*, Linn.; *Rangifer lapponicus*, Frisch. (Rangifer refers to the old French word "rangier," plus the Latin "fera," wild beast, while the common name, reindeer, is probably an adaptation of the Lapp "reino," pasturage, or of the Icelandic "hreinn," reindeer.) *Cervidæ*. Figs. 7, 605, 606.

By *C. C. Georgeson.*

The reindeer has been successfully introduced into Alaska, and efforts are now being made to introduce it into Labrador, to supply the inhabitants of the barren lands with meat and other products, and to afford a means of transportation. The reindeer is the only domesticated member of the deer family. Fundamentally, it is identical with the American caribou, although the latter has been divided into several species by mammalogists, the name "reindeer" being now applied, however, only to the European deer, both wild and domesticated, while caribou is the name of the wild deer found on the American continent.

Description.

Reindeer vary much in size. The food supply is an important factor in their development, as in the case of other animals. Again, breed—or, perhaps, we should call it race—characteristics are a factor having an influence on size. The average animal is three feet and nine inches to four feet at the withers, but some breeds are larger, as for example, the Tunguse deer in Siberia. Many of them stand five feet high and can carry a burden of two hundred pounds on their backs, and because of their strength are rather generally used for riding. Compared with other members of the deer family, the reindeer is not a graceful animal. The head is large, muzzle broad and nose covered with hair; neck short, set low and usually carried horizontally; when the animal walks, the top line of the neck is below that of the back; the withers are high, reaching above the line of the back; shoulders rather heavy, with prominent shoulder points. The back is narrow, rump sloping, hind-quarters light, flank low and rather full, and the under-line nearly parallel with the back. In the fawns, the legs seem disproportionately long, but in the mature animal, on the contrary, they appear rather short. The fore-legs are straight, but the hind-legs are crooked and spread outward from the hock as if to brace the hind-quarters. The feet are large and the hoofs spread when pressed against the ground—a provision of nature which aids the animal to get over soft snow or mud. The prevailing color of the domestic reindeer is a grayish brown—darker in summer, lighter in winter, but many are more or less spotted and some almost white. All are lighter on neck, shoulder and belly than on the back. The coat is thick, longer in winter than in summer, and underneath the neck the hair is five or six inches long. There is no mossy undercoat, such as most animals have that are indigenous to arctic latitudes. The hair is brittle and breaks readily when handled. For this reason, reindeer skins do not make good rugs. The hide is thick and impervious to water to a marked degree, and, by a certain mode of tanning practiced by the Lapps, it can be made perfectly impervious. On the face and lower parts of the legs, the skin is particularly thick and durable, for which reason the Lapps use these parts for footwear.

A peculiarity of the genus is that both males and females have horns, or antlers. They shed them annually in March and April, after which a new pair immediately starts to grow. The young animal has cylindrical horns, which grow to a foot or more the first summer; as the animal grows older the horns become palmated and curve outward and backward. The prongs or branches increase in number annually up to the age of seven or eight years; from that time they decrease in number, until in old animals there are only a few points on the outer ends of the horns. In the prime of life, one, or sometimes both horns produce flattened branches that reach down over the face. The size of the antlers varies with the size of the animal; those on females are smaller than those on males. Antlers have been found that measured four feet in length and weighed as much as forty pounds; but this is extreme. Half this length and weight more nearly represent the average on the domesticated animal.

It is not easy to see just what function the horns fulfill in the animal economy. They appear to be a hindrance rather than a help in the struggle for existence. It must be a vast drain on the system to furnish nourishment for their rapid and prodigious growth, and they are tender and of but little use for defence during the summer months while growing. They are at this season covered with skin, which is abundantly supplied with blood vessels, and a coat of fine hair. This condition is technically called being "in the velvet." They are full grown about the time the breeding season begins in the fall of the year, and then the males use them freely on each other. Otherwise, they are not of use either for offence or defence; instead, reindeer strike their antagonists with their fore-feet. Nor does the animal use the antler in digging away the snow to reach the moss underneath, for this is done with the feet and nose. The natural life of the reindeer is about fourteen years, and it does not reach its prime until it is six or seven years of age.

History of reindeer in Alaska.

Although the reindeer has been domesticated for ages by the Eskimos on the Siberian side of Bering Strait, the Eskimos on the American side have not kept it. They could not have been ignorant of the value of the deer, because trading expeditions from one side of the Straits to the other were of frequent occurrence. One is forced to the conclusion that they lacked the enterprise and thrift necessary to take up the work of reindeer-breeding. Instead, they hunted the wild caribou, which was abundant; they hunted the whale, the walrus and the seal, and the spoils of the hunt gave them their food, and the furs and skins afforded them goods for barter. With the coming of the white man all

this was changed. He killed or drove away the whale, beyond the reach of the Eskimo with the means at his command. The fur animals became reduced to the point of extinction; the caribou was killed or driven away. In addition to this, the white man introduced intoxicants, and his vices spread disease and destruction among these primitive people so as to reduce their power to pursue, as well as the amount of their food supply. This was the condition of the Eskimos in arctic Alaska, when, in 1890, Dr. Sheldon Jackson was sent to that region by the United States Commissioner of Education to establish schools. It became apparent to him at once that something must be done to provide the Eskimo with a food supply, and, in casting about for means to that end, it occurred to him that the reindeer would solve the problem. On his return to Washington, he urged that Congress should make an appropriation for the introduction of reindeer in Alaska. Congress did not act immediately, however, and as the needs were urgent. Dr. Jackson, with the approval and aid of the Commissioner of Education, Dr. W. T. Harris, made an appeal for funds through the public press, wherewith to begin the work. In response, the sum of $2,146 was received, and with this fund he began the purchase of reindeer in Siberia and their transfer to Alaska. The first importation consisted of sixteen head, which were landed in Unalaska in the autumn of 1891. During the summer of 1892, he made five visits to Siberia and purchased and imported 171 head of reindeer. These deer were landed at Port Clarence, where, on the 29th of June of the same year, the first institution in Alaska for the breeding of reindeer was established. It was named Teller Reindeer Station, in honor of Senator Teller, of Colorado, who had taken much interest in the enterprise. The government aided in the work, however, by assigning a revenue cutter to transport the purchased deer to Alaska. The first appropriation by Congress for the introduction of reindeer into Alaska was made March 3, 1893, and consisted of $6,000, to be expended under the direction of the Secretary of the Interior, who delegated the work to the Bureau of Education, and Dr. Harris, the Commissioner of Education, assigned the task to Dr. Jackson, who has thus been the prime mover of the enterprise throughout. The object was primarily to provide food for the Eskimos, but, before the deer could become of real benefit to them, it became necessary to teach them how to care for and handle the deer. The task was beset with difficulties. It meant a change in the mode of life of these primitive people. As fishermen and hunters their chief accomplishment was to destroy life; now they had to learn to foster and preserve it. It was a process of education. They had first to learn the advantages of the new life and then slowly and laboriously be introduced to it, and the plans that were finally adopted for the breeding and distribution of the deer were formulated with a view to meet these conditions.

Appropriations and purchase of deer.—From the first appropriation, in 1893, to the close of the fiscal year 1906, Congress had appropriated $222,500 for this purpose, in varying amounts from $6,000 to $25,000 annually, and in all, twelve hundred and eighty deer were imported from Siberia between the years 1892 and 1902. No importations have been made since 1902. Of these imported deer, 254 were the large Tunguse deer, a race or breed kept by the Tunguse people in central Siberia. These were purchased and introduced by Lieut. E. P. Bertholf of the Revenue Cutter Service, who was detailed for that duty. They are noted for their great size and strength. The herds brought here have done so well that it is deemed unnecessary to make further importations.

Plan of distribution.—Since the object of their introduction was to benefit the Eskimos, it was evident that the sooner they could be taught to handle and care for them the sooner the end in view would be attained. Arrangements were therefore made with a number of mission stations, already established at all the main settlements of natives, to become teachers of their wards. The government made loans of small herds, usually one hundred head, to these stations, as an outfit of

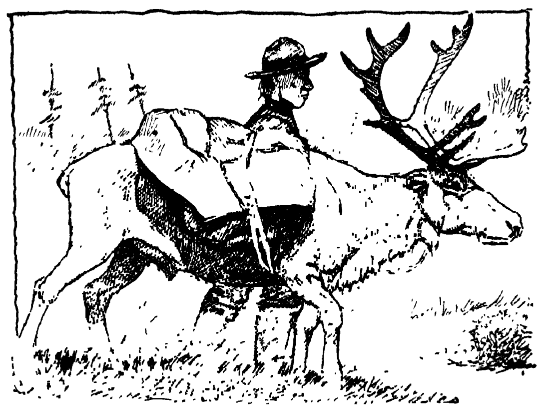

Fig. 605. Reindeer as pack animal.

industrial apparatus, the loan to be returned to the government at the end of five years, but the increase to remain the property of the mission. The slaughter or sale of female deer was strictly prohibited. Male deer might be sold, but only with the advice and consent of the government reindeer superintendent. The mission obligated itself to support a corps of apprentices, while under instruction in the art of herding and training the deer. The apprentices were selected from the brightest young men, and the average period of apprenticeship was fixed at five years. As a reward of merit, each of these young men who faithfully completed the stipulated period as a pupil was given a few deer, which were to form the nucleus of a personal herd. Competent teachers to instruct the apprentices were hired by the government. These instructors were Lapps who had been reindeer masters in their native country and who were brought to Alaska for the purpose. The government assumed general supervision over all the herds. At present, the reindeer territory is divided between two general

superintendents in the employ of the government, one having charge of the herds along the shores of the Arctic ocean and northern Bering sea, and the other having charge of the herds on the shores of Golovin bay, Norton Sound, and in the valleys of the Yukon and Kuskokwim rivers.

Stations.—According to Dr. Jackson's report, there were, in 1906, the following stations, with the number of deer at each:

	Deer
Barrow and Wainwright (Presbyterian mission)	797
Kivalina (native Eskimos)	279
Kotzebue (Society of Friends)	900*
Deering (Society of Friends)	649
Wales and Shishmaref (Congregational mission)	1,770*
Gambell, St. Lawrence island (Presbyterian)	250
Teller (Norwegian Evangelical Lutheran)	1,169
Golovin (Swedish Evangelical Union)	1,434
Unalakleet (Swedish Evangelical Union)	1,177
Eaton (Swedish Evangelical Union)	1,395
Bethel, Kuskokwim river (Moravian)	1,700*
Illiamna (Government)	535
Koserefsky (Roman Catholic)	320*
Tanana (Episcopal)	440*
Bettles, Koyukuk river (Government)	400*
	13,215

*Estimated. Report not in.

The missionary societies here named do not own all the deer accredited to their respective stations. In 1905, seventy-eight Eskimo apprentices had become the owners of a total of 3,817 deer, acquired partly as rewards of merit and partly through loans from the government on the same basis as to the missions. Several of the Lapp herders had in like manner received loans of deer from the government, as wages for their services, and all these various owners, with their herds, were located at the stations named. In 1905, when the total number of deer aggregated 10,241, the ownership was divided thus: Eskimo apprentices 3,817, government 3,073, mission stations 2,127, Lapp herders 1,224. These various owners kept their herds at the stations named, scattered from Point Barrow in the extreme north to Lake Illiamna on Cook Inlet.

Increase.—The average annual increase in the herds by fawns, from 1893 to 1905, was 45 per cent. This does not mean the number of fawns born, but the number that survived each year. As the herds increase in size the percentage of fawns that survive, however, is slightly diminished, probably due to the fact that the native herders are less vigilant than their Lapp teachers, who could give every deer individual attention when the herds were small; but it is assumed as a safe basis of computation that the increase will not fall below 33 per cent, and at that rate there will be 256,000 deer in Alaska in 1919. From 1892 to 1905, 4,184 deer were sold, butchered or died.

An importation from Lapland.—An experiment, which proved a failure, should be mentioned, because it has been advanced as a proof against the practicability of the reindeer enterprise. In the winter of 1897 the rumor spread that many American miners in the Yukon valley were on the point of starvation. Congress appropriated money for their relief, and it was thought that the best way to transport provisions to them was by means of reindeer. Pursuant to this plan, 539 trained reindeer and sixty-eight Lapp drivers with their families were imported from Norway and brought to the head of Lynn Canal, Alaska, from which point they were to start overland. Owing to unforeseen delays, the moss brought from Norway, on which to feed the deer, became exhausted before the start was made, and the alfalfa and other hay given them caused digestive disturbances which resulted in the death of most of the deer before they could reach the moss fields in the interior. In the meantime, word came that the report of starvation was untrue, and the expedition was abandoned. These deer were geldings, and form no part of the breeding experiments.

Distribution.

The reindeer occupies the arctic zone on both hemispheres. In the western part of the American continent the caribou ranges from the shores of the Arctic ocean, along the Alaskan range, through British Columbia to the boundary of the United States, and in the eastern part through Labrador to New Brunswick and Newfoundland, where it is yet numerous, while on the plains it ranges as far South as latitude 64. The domestic reindeer can also maintain itself, therefore, through the whole of this range.

In Europe, the reindeer is found throughout the northern regions of Norway, Sweden, Russia and Siberia, the range extending far below the arctic circle. It is found in Iceland, in Greenland, in Spitzbergen and other islands of the Arctic ocean, even beyond the eightieth parallel. It is domesticated in this extensive region, wherever man has a permanent abode, but more particularly by the Lapps in Norway, Sweden and Russia, and also by the tribes occupying Eastern Siberia from Kamtchatka to the sea of Okhotsk, and other regions of northern Siberia. In short, the present range of the reindeer and caribou is bounded on the south by the isothermal, which determines the character of the vegetation on which they feed, and on the north by the limit of mosses and lichens in quantity sufficient to sustain it.

In a by-gone epoch, the reindeer inhabited all of Europe, even down to the Mediterranean, having apparently been driven south by the advancing ice. Its remains have been found in France and elsewhere in continental Europe, and in Scotland and Ireland.

Caribou were numerous in Alaska until recent years. But, since the influx of the white man in pursuit of gold, the number is rapidly decreasing. In the Kenai peninsula they may still be found, although scarce, while in the interior they are now numerous only in the unexploited regions, more particularly in the so-called Alaskan range, in which Mt. McKinley is the principal peak In the winter of 1905-6, thousands of them crossed the Tanana river some miles below Fairbanks, and were slaughtered by the hundreds.

The reindeer occupies a zone wholly outside that in which agriculture is possible. It lives on lichen and herbage peculiar to the region where no agricultural plants will grow. It does not thrive in the warmer regions where agriculture is practicable, and it cannot live on the kind of forage we feed to cattle and horses. But it is by far the most useful animal under domestication for the region north of the agricultural belt. It is a means of transmuting a vast amount of otherwise useless vegetation into forms that can be utilized by man for food and shelter.

Training.

Training for the sled begins at the age of three years, and the stoutest males and geldings are selected. The lessons begin by lassoing the selected animals. The poor beasts are much scared and jump about in frantic efforts to escape. When quieted, they are led about for some time, or tied to a post to accustom them to confinement. They are then released, to have the lesson repeated day by day until they are tame enough to be harnessed, and in the same manner accustomed to draw light loads. This takes a long time and persistent work.

There are several methods of harnessing them. The most primitive and least humane consists in putting a raw-hide strap about the neck, and to this attach a single trace, which is either drawn between the legs, or simply stretched along the side of the animal, and fastened to the sled. An improved harness used in Alaska consists of a collar and a pair of light hames, from which a short trace goes back on each side to the ends of a swingletree, suspended under the body by a strap over the back. From the center of this, a single trace goes back to the sled, either between, or on one side of the hind-leg. This trace is covered with fur, to prevent it chafing the legs. A single line is fastened to the left side of the halter, and with this the animal is guided and held in check. In Alaska, as in Lapland, there is seldom more than one hitched to a sled.

The accompanying illustration (Fig. 606) shows two forms of the sleds used. The one placed above is imported from Lapland, and is there called a "pulka." It is seven feet long and two feet broad, pointed in front, and square in the back, and rounded underneath like a boat. It pulls easily and does not sink into soft snow. The other sled figured is like the dog sled or hand sled in common use. It is largely home-made, and varies in size and shape with the art and fancy of the maker. It is usually nine feet long and two feet broad, built of thin slats, and the top inclosed by a railing a foot high. It may or may not have handles behind to use in guiding it, or to hold on to when the driver runs behind for exercise.

Habits.

The reindeer is gregarious, and, when left to itself, pastures in great herds, sometimes numbering thousands. In summer it feeds on the twigs and leaves of the alder, willow and other shrubby plants, on lichens and mosses, and to a less extent on grass. In winter it lives almost exclusively on a whitish nutritious lichen (*Cladonia rangiferina*), which for this reason has been termed reindeer moss. It feeds also on other mosses and lichens, however, and is very fond of mushrooms. It is of a roaming disposition and is almost constantly on the move from place to place in search of food. For this reason a herd requires constant watching day and night to prevent its breaking up and stray-

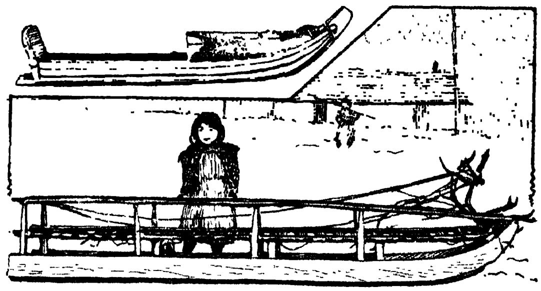

Fig. 606. Two forms of sleds used with reindeer.

ing off in different directions. It is timid like other members of the deer family, and a herd is easily scattered by dogs, wolves or other wild animals. It is polygamous, as are cattle. The rutting season occurs in the fall, and the fawns are dropped in March and April. If the weather then happens to be severe, there is large mortality among the newborn fawns. The herder's life then becomes strenuous, indeed. He cannot seek shelter himself, but must face the storm and give succor to the fawns by way of shelter and warmth.

Uses.

In Siberia and among the Lapps, where the reindeer is almost the only domestic animal, it supplies all the frugal needs of its owner. The meat is his chief food; from the milk he makes cheese, or he keeps it in frozen chunks for use in cooking, or it is made into butter; the blood is saved and eaten; the fat is used for food, for candles, and for making footwear and clothing waterproof; the skins are used for clothing, for tents, mats and blankets, straps and thongs; the bones and horns are used for tools and utensils, or, together with the hoofs, they are used in boiling glue; during life, the animal draws his sled over the snow and carries his burden. The reindeer thus enables part of the human race to secure a livelihood in a region where, without it, life would be well nigh impossible.

Their value tested.—That the reindeer is an unqualified success both as a source of food and as a means of transportation has been proved repeatedly in the last ten years. The most severe test to which they have been put was, perhaps, the relief expedition to Point Barrow, under the leadership of Lieut. D. H. Jarvis of the Revenue-Cutter Service, in the winter of 1897–98, when the whaling fleet froze in and some 300 whalemen faced starvation. Lieutenant Jarvis, assisted by Lieut. E. P. Bertholf, Surg. S. J. Call, Mr. W. T. Lopp, and some natives, drove a herd of several hundred deer for more than 800 miles, across the barren snow-cov-

ered, uninhabited waste, from Norton Sound to Point Barrow, during the dead of winter, with the temperature 20° to 50° below zero, and brought them safely to their destination. The deer found their own food in the moss which they uncovered by scraping away the snow, and on arrival in April a large number of healthy fawns were born to the herd. The leading participants were awarded gold medals and the thanks of Congress. Reindeer have also been employed to carry the mails between the scattered settlements along Bering sea. They have the advantage over dogs that it is not necessary to carry their food with them.

Diseases and disabilities.

Hoof disease, perhaps, is the most troublesome affliction of the reindeer. It produces a swelling above the hoof, with a formation of pus. Opening the swelling and treating it with disinfectants may result in a cure; or it may become systemic, in which case the animal usually dies. An affliction designated "*liver and lung disease,*" resulting from an affection of the spleen and from congestion of the brain, is usually fatal. No adequate remedies appear to have been discovered. The great number of savage, wolf-like dogs that infest all Indian and Eskimo settlements in Alaska wound and kill many deer, and are a great drawback to the handling of the herds. The reindeer is also very prone to accident. The bones are brittle, especially during the summer, when the antlers are growing fast. Many deer break their legs, their necks, or their backs while running about, or while fighting with each other.

Reindeer for Labrador.

By *D. W. Prowse.*

Guided by the good results secured in the introduction of tame reindeer into Alaska by Dr. Sheldon Jackson, the Governor of Newfoundland, Sir William Macgregor, and Dr. Grenfell, of the Deep Sea Mission to Labrador, very earnestly took up the project of introducing domesticated reindeer into Labrador. Before the scheme could be carried out practically, measures were taken by the Governor and Dr. Grenfell, assisted by the Moravian missionaries at Labrador, to ascertain whether the common food of the caribou existed in sufficient quantities all over the peninsula. Specimens of mosses, lichens and grasses from every part of the great peninsula were collected. These were carefully arranged and sent to the authorities at Kew, England, for classification and identification. They were pronounced to be the true reindeer moss and the actual common food of the reindeer. This was a foregone conclusion, as the native caribou were known to have been abundant at Labrador. The indiscriminate slaughter of the herds by the Eskimos has driven them farther inland, but they are still fairly abundant, although not to be compared with the vast herds of Newfoundland.

With these preliminaries settled, the next problem was to secure funds for the experiment. Dr. Grenfell toured the United States and Canada, and aroused much interest in the undertaking. The Canadian government made a grant of $5,000 for the work. The Newfoundland administration may also assist. Together with private subscriptions, sufficient funds were collected to begin the enterprise, and it is now in the process of accomplishment.

The purpose of the undertaking is largely the same as in the Alaska importations, namely, to provide food and other products, and a means of transportation for the people living on barren Labrador. The place for the landing of the reindeer has been carefully chosen. Lapland herdsmen will instruct chosen apprentices from among the natives in the handling of the reindeer, and, eventually, if the experiment succeeds, the animals will be parceled out to the natives. Much interest centers in this venture, as far-reaching results may be expected if it is successful.

In this connection, the question arises, why not domesticate the native wild caribou? Every year fawns are taken and trained, and they make delightful pets. But thus far it has been impossible to eradicate the wild nature, and it would probably require many generations to develop a domesticated type.

About $13,000 was collected, and in 1907, after a highly satisfactory voyage, a herd of 300 domesticated Lapland reindeer were landed in northern Newfoundland, accompanied by Lapland herdsmen and dogs. As soon as navigation opens up, a part of the herd will be taken to Labrador. Some fifty reindeer were also brought over by the Harmsworth Company, and have been placed on their estate at Grand Falls, Newfoundland. So far, the experiment has been a complete success, and the reindeer are reported to be in excellent condition.

SHEEP. *Ovis aries,* Linn. *Bovidæ.* **Figs. 50–54,** 133, 288, 607–638.

Sheep-farming in North America has passed through several phases, and it is now represented by several rather distinct types of effort. In the eastern states, sheep-farming is a business of small flocks that are kept within fenced fields and are housed in winter in regular barns. The European system of shepherded flocks is practically unknown anywhere in this country, due to the price of labor, the fact that persons are not trained to the business of shepherds, and to general economic and social conditions.

In the great West, a characteristic American type of sheep-ranching has developed, on a very large base. This ranching is subject to ups and downs, depending on the price of wool and mutton; but as a general statement it may be said that it is following the large-area cattle-ranching, which is now passing away. Sheep can subsist on lands that are not adapted to cattle-ranching, and the returns from sheep are rapid, as there is a crop each year of both wool and lambs.

The business of winter sheep-feeding has now grown to great proportions. This consists in the feeding of purchased sheep—chiefly range sheep of the West—for the winter and spring market. Immense feeding enterprises of this kind are con-

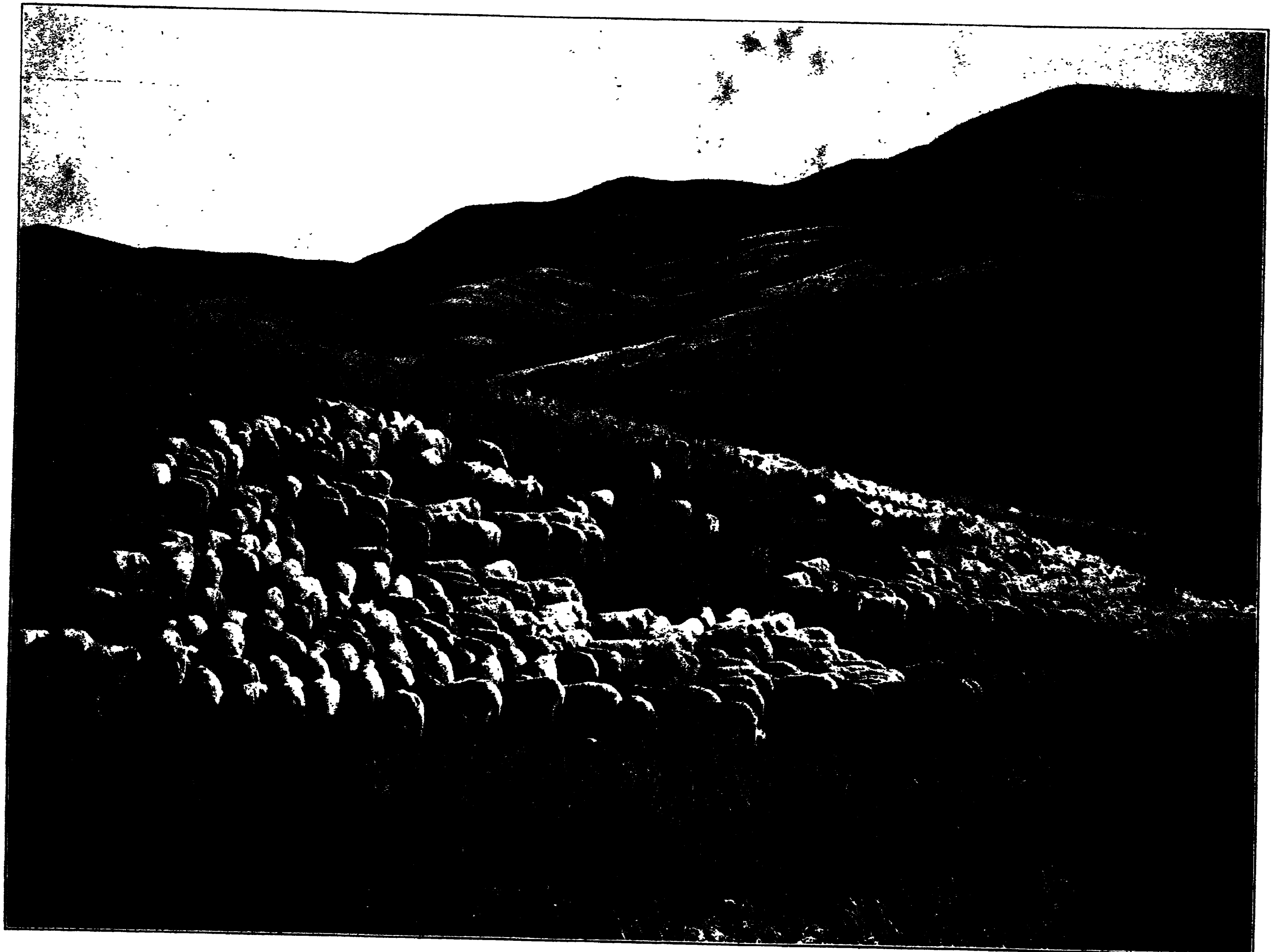

Plate XXI. Sheep range in Utah

ducted in the sheep states, as in Colorado, Montana, Wyoming, the animals being brought down to the feeding-pens from the high summer ranges. These "feeders" are also shipped into the East, as far as New York, where great numbers are now fed in barns and sheds, in close proximity to the markets.

Because of the great areas of cheap lands and public range in parts of the West, sheep-farming has largely passed out of the East. The equilibrium promises soon to be restored, however. Not only will the old style of sheep-farming be revived, but it is probable that something like the range effort of the West will come into the cheap-land hill regions of the East. Many of the semi-abandoned areas are excellently adapted to sheep, particularly when several farms can be combined, or when the owners can agree to engage in a similar business. In some cases it will probably be found to be more economical to introduce a system of shepherding than to attempt to re-fence the old arms.

Another type of sheep business is the rearing of "hothouse lambs." Ewes are bred at such time that the lambs are dropped early in winter, and the lambs are fattened by forced feeding and extra care, and are ready for market in about sixty days. Not all sheep, or all kinds of sheep, will breed freely at this time of the year (in June or summer: the period of gestation for the sheep is five months), and importations of Dorsets and others have been made for this purpose. It is now a prevailing opinion that the mountain-bred sheep of the West are well adapted to this business, whether because they are mountain-bred or because they are of the proper type for this business, is not determined. The long-wool kinds do not breed well for this purpose, nor do the lambs fatten quickly. The Merino types give better results but the pure Merinos seem to lack in milk-producing and other qualities for the best production of winter lambs. The middle-wools, as the Dorset, are now preferred, the large producers of hothouse lambs securing their ewes mostly from the West, but the smaller producers breeding their own stock. The ideal season for winter lambs to be dropped is November, but it is difficult to make sheep breed early enough for this, so that December-dropped lambs are more common. The hothouse-lamb business depends on very special markets and it does not appear to be increasing at present.

It must not be inferred that the sheep business has actually left the East, for this would be erroneous; but in some regions it has decreased, and in few has it developed coördinately with other agricultural business. The business of breeding sheep, as well as the general rearing for mutton and wool, is important in many eastern regions, particularly in parts of Canada; the interest in high-class animals has not died out for sheep more than for other live-stock; there are many sheep-breeders' societies in the East; and at present the interest in sheep in that region is rapidly increasing. One of the great handicaps to sheep-husbandry is the danger from dogs. Tight woven-wire fences prove to be effective barriers to dogs; but the only real relief is to make all dog-owners legally responsible for the acts of their dogs, and this can readily be done and the law can be effectively enforced when the sheep-growing sentiment of the community is well developed.

The western ranching.

The sheep-farming of the mountain states of the West is practically a pasturage business. Advantage is taken of the very high pastures in summer, and of the plains in winter. Immense flocks or "bands" are kept, being moved from place to place as the pasturage dictates. This nomadic business requires men and a regular "outfit" of camp equipment that move with the sheep. The work is done in a wholesale way, with very few of the niceties of care and feeding but with an excellent business management of the entire enterprise. The sheep are exposed to many risks and the losses of animals are likely to be great. The real range ranching business is largely speculative. It is often spoken of as a "game." With the passing of the public range, this type of business will recede, and a kind of fenced farming, with fewer risks, will take its place, although, because of the character of the land, great areas will still be held in single ownerships and large flocks will be kept.

For years there has been dispute and contention between the cow-men and the sheep-men as to the occupancy of the public range. This contention has often taken the form of open violence, usually, in the past, to the disadvantage of the sheep-men, who have sometimes lost whole flocks by having them driven over cliffs and into canyons and by other means. With the passing of the big cow-men, however, and the growth of the sheep business, the sheep-men have now gained supremacy in many parts. This old strife will soon be a part of the romantic history of an unsettled country.

In so vast a region, it is to be expected that the practices will vary greatly; but it is possible to present a graphic picture of features of the business as it is followed in at least part of the great West.

The essential features of the sheep-ranching of the West are the winter range and the summer range. The winter range is the home area or the place of business. It is on the plains or in a valley. It may be an enclosure or domain of several hundred acres or several thousand. It usually becomes parched in summer, and it is also too hot for the best success with sheep.

The summer range is on the high lands, often above timber-line and near the snow-line. Here the grasses are fresh and nutritious, and the climate is cool. To the summer range the sheep are taken—either "trailed" or shipped by train—just after shearing, and here they remain till the season closes. The summer range is usually not owned by the sheep-man. The summer range will be unavailable with the settling of the country, and this will determine the extent of the business.

On the summer range the sheep are in charge of herders, whose business it is to see that the band is moved on to fresh pastures, that the band is kept together, that poisonous weeds (page 119) and wolves are avoided, and to look after the sheep that are dropping lambs and to take care of the

lambs themselves. The herder remains with the band the entire season. The sheep may be herded by corralling them or by allowing them to run free. The corral is made of board fencing in panels fourteen to sixteen feet long and about four feet high, which is transported by wagons. The corral is made near a water-hole or spring, and is moved when the pasturage becomes poor.

The free ranging allows the sheep to drift over the country, being guided by the herder and his dogs. The herder lives in a covered wagon. Often there are two men, one man doing most of the herding, on horseback, and the other cooking and acting as assistant. If the band contains only 2,000 to 2,500 sheep, only one herder may be needed and he may not have a horse; the camp-tender visits him two or three times a week, bringing provisions and moving camp.

In whatever way the herding is done, the men on the range are supplied with "grub" from headquarters once or twice a week, taken out by a camp-tender. One tender makes the rounds of all the herders in an "outfit" or single ownership. A hardy and self-reliant lot of men are bred in this herding business, but the occupation lacks the picturesqueness of the old cowboy days. When the summer ranging is over, the herders go to headquarters and are assigned duty on the winter range.

Plains that are apparently lifeless in summer often afford excellent grazing after the rains come. The sheep roam at large all winter, securing feed from various plants and the natural hay made of the dry grasses. In many establishments, cheap sheds are provided on the winter range where supplemental feeding may be given in very cold weather or when the snowfall is heavy. These sheds are usually covered with wild hay. A shed one hundred feet square will provide feeding-place for 2,000 to 3,000 sheep. Seventy-five tons or less of hay should provide winter feed for 2,500 sheep.

Wethers are handled in bands of 2,000 to 3,000 animals. Ewes are handled in bands about half this size, for the care of lambing sheep is arduous. The weather is often rainy at the lambing season. The new arrivals, when first dropped, must be kept under cover if the weather is not bright and warm. The herder in charge of the "drop band" must keep a sharp lookout for ewes that are having lambs, for these sheep, with their lambs, must be hauled to the main corral. The wagon for this work is divided into compartments, altogether holding about twelve ewes. The man driving this wagon goes to the herder and determines how many ewes have had lambs and where they are. The teamster then catches the ewes and, seeing that the lamb has had milk, he puts ewe and lamb in a compartment. He then takes them to the main corral, where the man in charge checks up the ewes and sees that they all claim their lambs.

There is often trouble if the ewe is roughly handled and she is frightened, for when turned loose she may leave her lamb. In this case, the corral man catches her and puts her in a "claiming pen.' This pen is just large enough for her to stand in, and yet give the lamb a chance to get milk without being butted away. If the ewes all "claim," they are taken to a small corral that will hold about one day's drop, with good pasturage near. One day's drop on the start, with 2,500 ewes, will be 25 to 30 lambs, increasing to a maximum of 100 to 150 in the middle of the period. These small bunches of ewes and lambs are moved from one small corral to another to make way for different days' drop; and after ten days they are merged into what is called a "lamb band." This band is added to daily as the lamb become strong, and, finally, when all the ewes have lambed, it becomes the main band. The lambs that come in the night are separated, with their mothers, by the night man, who patrols the corral all night.

It requires about ten men to "lamb" a band of 2,500 ewes, and this is as many as can be lambed together with good results. When the lambs are about a month old, their tails are cut off, they are ear-marked, and the ram lambs castrated. To ascertain the percentage of increase, the tails are

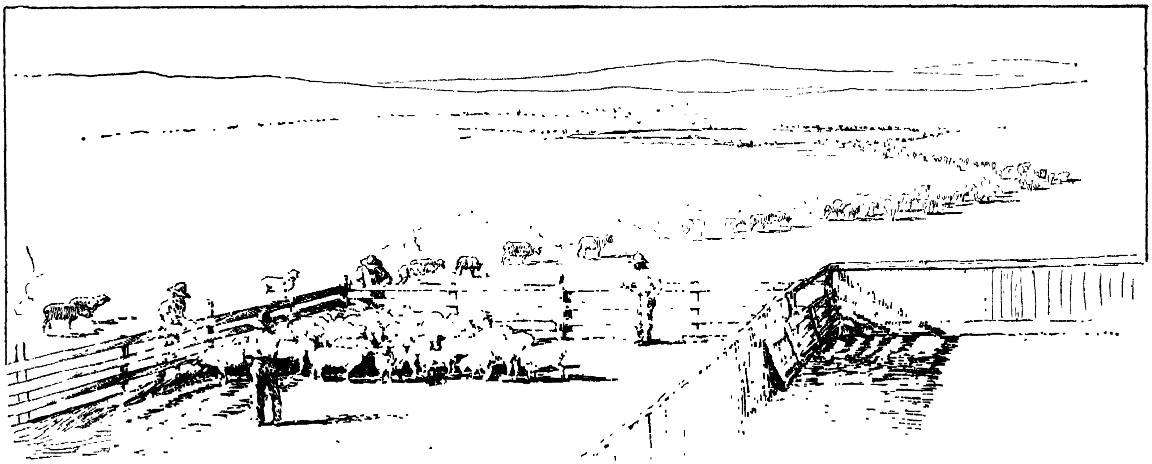

Fig. 607. A Montana sheep corral and range. Water-hole in the distance.

counted, this giving the exact number of lambs. The average increase, one year with another, will be from 75 to 80 per cent. This means the lambs that are counted in the autumn. It is generally estimated that it costs twenty-five cents per head for every lamb dropped, but this depends on how close expenses are watched.

Probably there is no place in the world where the sheep-dog is more useful than in this ranching in the great West. The dog is a Collie, light, quick, intelligent. The pup is usually trained by working him with an older dog. The dogs bring in the straggling sheep, round up the flock, look out for wolves and other dangers, and guard the outfit. They are the objects of much affection by the sheep-men. They work persistently on rough and often cactus-covered lands, and share with the herder his privations of food and water. This use of the sheep-dog (see page 383) is in marked contrast to the damage done the sheep industry in other regions by untrained and irresponsible dogs.

It is said that the dog and western wolf cross, and that the hybrid animal is preferred by some herders as being hardier and also tougher in the feet. Others say that the dog and coyote cross. This cross is said to partake of the color of the coyote, but, when the dog parent is a collie, the animal carries himself more like a dog, holding his head in the air rather than carrying it down as the coyote does. The fact that no systematic efforts are put forth to make either of these crosses, raises a question as to their value, if they occur.

As a general proposition, the sheep-rancher calculates that the wool crop will pay the cost of the business. This leaves mutton and lambs to represent the profits. Although the chief crop is wool, yet, where so many sheep are raised, there are a great number of mutton wethers shipped out each year. The major part of this mutton product goes East, chiefly to Chicago. The sheep that are in prime condition and fat go directly on the market. They will average about 110 pounds, and bring from \$3.50 to \$4 per hundred live weight. It costs from 60 to 75 cents per head to ship and care for them in transit. They are shipped in double-decked cars, each car holding about 225 sheep, this, however, depending on the size of the sheep. From points in Montana, these sheep are unloaded and fed twice before reaching Chicago. They are finally delivered at some of the numerous feeding stations near the market, where they are held for a few days and generally put on the market in from two- to six-car lots. The commission man regulates the quantity, however, and orders from day to day the number of cars he thinks he can sell to the best advantage. The sheep that are not in shape to send to market at once, are put on feed. This feed consists of mill screenings, corn and hay, all of which is given them for about ninety days.

The sheep intended for long feeding are generally put in the feed-pens during the autumn and winter. Very few, if any, are fed in summer. In late years, the farmers of Michigan, Illinois and Indiana have fed great numbers of western sheep. They seem to have made good profit, for they secure the market price or better for their grain and hay by feeding it, and they have the manure and are able to find employment for their men.

The shearing on these ranches is performed by men who go from place to place, beginning early in the South and working northward with the season. The work is done by piece or contract, either by hand or with clippers run by electric, steam or gasolene power. Although the machine is nearly as slow as hand-shearing, it does cleaner work and therefore gives the owner a heavier fleece. An expert workman will shear about one hundred sheep per day on an average, although the number runs as high as 150 sheep in ten hours, and it is said that there is a record of 308 in this time. At eight cents each, a shearer expects to earn \$8 to \$10 a day.

Great numbers of high-class sheep have been introduced into the western sheep regions in recent years, largely of the fine-wool and middle-wool classes, and these are having a marked effect on the flocks. Sheep-breeding centers are developing in the West. From its natural adaptabilities, the region will always remain a great mutton and wool country.

The number and farm value of sheep in the United States, and in the seven leading states (all above a farm value of \$10,000,000), on January 1, 1907, are given in the Yearbook of the Department of Agriculture (1906) as follows:

	Number	Farm value
United States	53,240,282	\$204,210,129
Montana	5,636,711	20,833,283
Wyoming	4,986,796	19,244,045
Ohio	3,140,720	15,119,427
New Mexico	4,558,365	13,468,363
Idaho	3,648,133	13,184,353
Utah	2,853,250	11,131,953
Michigan	2,108,795	10,314,117

The wool-product for the United States, and of the eight leading states (all above 10,000,000 pounds), is given in the same Yearbook as follows:

	No. of sheep April 1, 1906	Wool washed and unwashed lbs.
United States	38,540,798	256,915,130
Montana	4,940,000	35,815,000
Wyoming	4,531,000	32,849,750
Idaho	2,300,000	16,905,000
New Mexico	2,900,000	15,950,000
Oregon	1,800,000	15,300,000
California	1,750,000	13,125,000
Utah	1,900,000	12,350,000
Ohio	1,850,000	11,562,500

The imports and exports of wool, unmanufactured and raw, for the seven months ending January 1, 1906, 1907, 1908, are given as follows in the Quarterly Report of the Treasury of the United States:

	Pounds	Value
Imports—		
1906	100,180,796	\$18,165,727
1907	95,339,555	17,532,704
1908	71,205,366	13,860,068
Exports—		
1906	11,375	\$2,126
1907	169,824	40,118
1908	41,763	12,005

The Yearbook of the United States Department of Agriculture for 1906, gives the number of sheep in Canada as follows:

	Year	Number
Total Canada		2,971,212
New Brunswick	1905	183,000
Ontario	1906	1,304,809
Manitoba	1906	28,975
Saskatchewan	1906	121,290
Alberta	1906	154,266
Other	1901	1,178,872

The Canada Yearbook for 1905, gives the value of sheep in 1901 as follows: Total Canada, \$10,-490,594; British Columbia, \$164,679; Manitoba, \$144,018; New Brunswick, \$538,682; Nova Scotia, \$757,278; Ontario, \$5,518,403; Prince Edward Island, \$384,790; Quebec, \$2,376,471; Territories, \$606,273.

Literature.

Probably the one book that has had most influence on American sheep-husbandry is Randall's "Practical Shepherd," by H. S. Randall of Cortland, N. Y. Since the publication of this work the character of the business has changed radically, and no single book now has undisputed precedence. Following are some of the titles: Youatt, Sheep: Their Breeds, Management and Diseases, London (1837); L. A. Morrell, The American Shepherd, New York (1846); H. S. Randall, The Practical Shepherd, Rochester (1863); same, Fine Wool Sheep Husbandry, New York (1868); same, Sheep Husbandry, New York (1883); Powers, The American Merino, New York (1887); Spooner, Sheep; History, Structure, Economy, Diseases, London (1888); Henry Stewart, The Shepherd's Manual, New York (1890); same, The Domestic Sheep, Chicago (1898); Carman, Heath and Minto, Special Report on the History and Present Condition of the Sheep Industry of the United States, Washington (1892); Wrightson, Sheep: Breed sand Management, (1893); Coleman, Cattle, Sheep and Pigs of Great Britain, London (1887); Craig, Judging Live Stock, The Author (1904); George W. Curtis, Horses, Cattle, Sheep and Swine (1888); David Low, On the Domesticated Animals of the British Islands, London (1842); Wallace, Farm Live Stock of Great Britain, Edinburgh (1907); Shaw, The Study of Breeds in America, New York (1905); Sanders, The Breeds of Live Stock, Chicago (1887); The Best Breeds of British Stock, London (1898); Plumb, Types and Breeds of Farm Animals (1906); J. E. Wing, Sheep Farming in America, Chicago (1905); Rushworth, The Sheep, Buffalo (1899); Milburn, Sheep and Shepherding; Bennett, Wool and Sheep; Miller and Wing, The Winter Lamb; Clarke, Fitting Sheep for the Show Ring and Market.

It is seen that the literature on sheep is abundant. These little animals have long been popular with writers, popular and scientific, and as well with those who delight to use the camera. Numerous illustrated articles are to be found in the current magazines. There are many experiment station and government publications on sheep, which may be traced through the Experiment Station Record.

INDEX TO SHEEP ARTICLES

Origin of the Domestic Sheep.

Our domestic sheep have probably been derived from more than one species of the genus Ovis. They are supposed to have been descended from the argali, or wild sheep, of Asia (*Ovis ammon*), and the musimon of the south of Europe (*Ovis musimon*).

The argali, or wild sheep of Asia, is a larger animal than our common sheep, being somewhat smaller than a stag. The argali possesses enormous horns, sometimes a foot in circumference at the base and three to four feet long. The color of fur is brown, with a buff-colored streak along the back and a large spot of buff color on the haunch. These animals are found on the elevated plains of Asia from the Caucasus northward and eastward to Kamschatka and the ocean. They are very agile and strong, but wary and suspicious. They roam together in small flocks. They are hunted for their flesh and their skins, which are made into clothing. Taken young, it has been found possible to tame them, but adult wild animals never become thoroughly domesticated.

The musmon or mouflon (Fig. 608) inhabits the islands of Crete and Cyprus and the mountains of Greece. It is also still found in Corsica and Sardinia. It is much smaller than the argali, less powerful and active and inhabits a lower range of mountains. The musmon roams in large herds, and is with difficulty domesticated. The musmon has been crossed with the common sheep and the progeny are fruitful.

Whether these two wild forms are really to be regarded as distinct species, and whether our common sheep have descended from them, or either one of them directly, or from a related form now extinct, are questions that do not appear to have been settled by zoölogists. There are other forms of wild sheep in many parts of the world, but they apparently have not contributed to the common domestic races. All members of the sheep tribes are mountain and highland animals. In fact, there are few animals that live in more inaccessible and inhospitable heights. Our domestic sheep inherit

this peculiarity, preferring cool climates, high lands, open ranges, and quickly suffering when closely housed for any length of time.

In North America there are three species of wild sheep,—the big-horn (*Ovis canadensis*, sometimes called *O. cervinus* and *O. montanus*), the black sheep (*Ovis stonei*), the white sheep (*O. dalli*). There are two or three subspecies or forms of these. Of these, the best known is the big-horn, native to the mountain region from Mexico to

Fig. 608. The musimon (*Ovis musimon*). Adapted from Brehm.

British Columbia, but are most abundant in the northern parts of the United States and parts of Canada. This animal, which is considered as one of the "big game" of the West, is characterized by immense horns curled downward at the sides of the head. It stands, when mature, about forty inches high and weighs 325 pounds. It is yellowish in summer and gray-brown in winter. It is exceedingly alert and very difficult to capture. There is now a herd of about two hundred head of these fine animals in the Yellowstone Park, roaming free. There appears to be none in captivity, nor has any effort been made to breed them. The white sheep and black sheep are smaller than the big-horn, with much lighter horns. The white is an Alaskan species; efforts to bring it into captivity have failed. The black sheep is native to British Columbia; specimens are in several zoölogical parks.

Not to be confounded with the big-horn or other mountain sheep are the "wild sheep" or "native sheep" of the West and South, which are degenerate and run-wild forms of domestic sheep early introduced by the Spaniards or others. With the settlement of the country, better blood is being introduced and the scrub range sheep are passing out.

An animal that may be confused in the popular mind with the big-horn and the "native sheep" is the mountain goat (*Oreamnos montanus*). This is a goat only in looks. It is more nearly allied to the antelopes. It inhabits the highest ranges and peaks from Idaho and Washington to Alaska. The male animals weigh as much as 300 pounds when mature. The mountain goat has a coarse shaggy coat of white hair and nearly straight erect shining black horns. It is a peculiar beast, quite unlike any other animal in any part of the world. No efforts have been made to domesticate this animal, but a few specimens are in captivity.

As is to be expected of an animal that has been long under domestication in many countries, the sheep presents many forms. The animal is grown chiefly for wool and meat, and there are breeds valuable primarily for wool and others primarily for mutton. There are variations that are not correlated with these uses, however, as those with three, four or more horns, and those with no horns. There are short-tailed and long-tailed breeds, and there is an Asian breed with very thick fat tails. There are also dwarf races, as the Shetland and Faröe island sheep, yielding a fleece of two pounds or less, which is pulled instead of being sheared. There are many kinds of fleece. Some kinds of sheep have a marked double coat, and in tropical countries there are woolless sheep. The Shetland and similar sheep have a fleece with hair intermixed; in fact, this intermixture is characteristic in cold, moist climates. Sheep differ greatly in color, the exposed parts being soft white or sometimes jet-black. There are Asian forms with an extreme development of fat on the haunches.

In Roman times, the mountains of Spain were recognized as excellent sheep countries; and as more northern regions were not then civilized, the Spanish sheep early gained great prominence. The Spanish sheep is a fine-wool type. The English developed coarse-wool types, apparently not from Spanish foundations. The early Spanish introductions to North America gave character to our early sheep husbandry. Later, the long wools and middle wools of England were introduced, and they are now the prevailing types. The character of the introductions from Europe has changed from time to time, depending very largely on the tariff conditions and the general nature of the demand for wool-stuffs.

The domestic sheep is a good illustration of the influence of domestication. The modern animal has very few characters that would indicate its descent from the wild species. Sheep have been under subjection to man from earliest recorded time. Abraham's wealth was measured by his "sheep and oxen and camels." The peculiar sheep-herding methods recorded in scripture are followed today by the Kurds, Turcomans and Arabs of Asia. There are remains of sheep in the prehistoric lake dwellings of Switzerland.

The character of the wool has given rise to the classification of breeds. The domesticated varieties of sheep are numerous. In this article only those of most importance to America are considered. The breeds most prevalent in America are the Merino, a breed noted for the fineness of its fleece, and the Shropshire, Hampshire, Oxfordshire, Southdown, Horned Dorset and Cheviot, sometimes

called middle-wooled breeds, but more frequently spoken of as mutton sheep. The Lincoln, Leicester and Cotswold are large breeds with long, coarse fleeces, primarily raised for their flesh.

It has been a common practice to classify sheep according to the length or quality of fleece produced. Thus, we have (1) fine-wool breeds : American, Delaine and Rambouillet or French Merinos ; (2) medium-wool breeds : Dorset-Horn, Hampshire Down, Oxford Down, Shropshire Down, Southdown, Suffolk Down, Tunis; (3) long-wool breeds: Cheviot, Cotswold, Leicester, Lincoln. Another classification would group the breeds, according to utility, into the fine-wool type, as (1) above, and place all the others together under the mutton type. There are numerous miscellaneous breeds, not included in this classification, as Black-Faced Highland, Kent or Romney Marsh, Wensleydale, Herdwick, Ryeland, Barbados.

Wool- and Mutton-Production.

By *G. C. Humphrey.*

The production of wool and mutton is an industry of very great proportions, and of increasing national interest.

Wool-production.

Wool is a staple article, very essential to all mankind. Next to cotton, it is the product most extensively used in the manufacture of cloth, felt and other fabrics. Argentina, Australia, America, Russia, Great Britain and British India are the most noted wool-producing countries. According to an estimate made by the National Association of Wool Manufacturers, the world's wool clip for 1900 was 2,685,000,000 pounds. The United States, in 1905, as reported by the National Department of Agriculture, produced 298,915,130 pounds of wool, equivalent, when scoured and ready for the manufacturer, to 129,410,942 pounds.

For many years, sheep-breeders in America devoted their main efforts to the improvement of wool, and developed some excellent types of the American and Delaine Merino breeds. These were most popular when sheep were reared principally for wool-production, and prices for wool were comparatively high. Since the marked decline in the prices in 1893, and the demand and prices for mutton have increased, sheep-growers, especially in the East and middle West, have turned their attention largely to the medium-wool mutton breeds, and have had little regard for the improvement of wool. The time undoubtedly will never come when the sheep-grower can afford to ignore the value of his flock for mutton-production, but he likewise cannot afford to ignore or neglect the improvement of wool.

Improvement of wool.—In all instances, wool is incidental to the growth and existence of sheep, and any improvement in its character insures greater profits in sheep-rearing. At the present time, to say the most, wool is very much neglected and badly handled in America. On the ranches of the West and the Southwest, more attention is given at present to wool-growing than in the eastern states. Experience has taught that the fine-wool breeds, especially the strong-bodied, well-wooled Rambouillets, are more hardy and more capable of withstanding range conditions than are the Down breeds. The ranchman has also learned that he can better afford to produce and market a good clip of wool than attempt to fatten sheep for market. He can grow lambs for feeders, and for this reason, a breed that will combine wool and mutton qualities is being sought. The United States Department of Agriculture is lending aid to this project through the Wyoming Agricultural Experiment Station, which is endeavoring to establish and develop a breed of sheep highly adapted to the range.

Great improvement can be made in the wool of all breeds, without altering their other characteristics, by giving careful attention to the selection of pure-bred rams that are well-wooled, providing better feed and shelter, and giving more heed to keeping dirt and foreign substances out of the fleece. A good fleece should be dense and even over the entire body ; be free from foreign substances, kemp and cot ; possess a strong, well-crimped fiber of bright and lustrous appearance ; and have sufficient yolk or oil to preserve and keep the fiber strong. Exposure and lack of proper nourishment affect the value of wool from the point of view of the manufacturer, who buys wool on its merits and is dependent on the grower for the quality. There should be a close relationship between the grower and the manufacturer, which would force the local buyers and commission men to make more distinction between prices paid for different lots of wool than they are accustomed to make.

Classification and grades of wool.—According to Mumford, wools are classified on the basis of their length and strength as (1), clothing wools, comprising short, fine wools suitable for making high-grade woolen cloth ; (2), combing wools, which are strong, over three inches long, used for worsted goods ; and (3), delaine wools, which are fine, strong wools, two to three inches long, desirable for making delaine cloth.

Clothing wools, according to the fineness of their quality, grade as Picklock, XXX, XX, X, No. 1 or ½ blood, No. 2 or ⅜ blood and No. 3 or ¼ blood. Picklock and XXX are very rare grades, which formerly found their way to American markets among imported wools. Combing wools do not grade higher than ⅜ blood. Delaine wools grade as fine, medium and low.

Marketing wool.—All wools that are bright and comparatively clean are termed "domestic wools." Dirty and discolored wools are quoted as "territory wools." The bulk of wool is marketed today as "unwashed" or in the grease," which refers to wool with dirt and yolk adhering to it. Formerly, it was the common practice to wash sheep and remove a part of the dirt and yolk, when the wool was marketed as "washed wool." "Tub-washed wool" is wool that has been washed by hand or machinery after it has been taken from the sheep.

"Scoured wool" is factory-washed wool, from which all dirt and yolk have been removed and which is ready for the manufacturer.

Growers should familiarize themselves with market demands and quotations, endeavor to remove all features that are objectionable to the manufacturer, and insist that local buyers and commission men pay prices corresponding to the merits of the wool.

Mutton-production.

The rearing and feeding of sheep for the production of mutton is today a prominent feature of the live-stock industry. The number of sheep slaughtered during the years 1880 and 1907, respectively, at the Chicago Union Stock Yards, the greatest packing-house and live-stock center in the world, indicates the growth of the sheep industry and the popularity of mutton as an article of food. In 1907, there were 3,069,391 sheep slaughtered at this point, as compared with 179,300 in 1880. Prices paid per hundred pounds in 1907 for sheep, grouped in the following classes, ranged, according to the grade, as follows: Native sheep, $2 to $7; native yearlings and lambs, $4 to $8.60; western sheep, $2 to $7.25: western and Mexican lambs, $4 to $9.25. These prices, on the average, have not fluctuated materially for the past ten years, although the sheep market tends to fluctuate at certain seasons of the year in a manner greatly to concern feeders having large flocks to market.

Methods of producing mutton.—Several methods of feeding and fitting sheep for the market are in practice. One is the forcing of lambs from the time they are dropped until they are six to ten weeks old, when, if properly fitted, they furnish the finest quality of mutton and bring the highest market price. When special houses are provided in which to force this class of lambs, whatever may be the season of the year, the term "hothouse lambs" is given them. Such lambs, depending on the season they are produced, are also termed "Christmas," "winter," "Easter" or "spring lambs." They are much sought, and, when one understands breeding and forcing them, large profits are derived. The cost of production, so far as feed is concerned, is relatively low; but unless one has suitable buildings and is willing to devote the utmost care and attention to the work, he had better be satisfied to produce mutton after some other method.

The selection of ewes that will breed at the proper season of the year, be prolific and produce an abundance of milk, is the first consideration. The profits come in having the lambs at some extraordinary season, when extremely high prices will be paid for them. Consequently, one must aim to breed the ewes much earlier than the usual time. Dorsets are the most popular for early lamb production, since it is characteristic of them to breed at any season of the year, be prolific and produce an abundance of milk. The Rambouillet, Tunis, Hampshire and Delaine breeds are also worthy of consideration, if one can select choice deep-milking ewes.

At the Wisconsin Agriculturul Experiment Station, six ewes, four being grade Dorsets and two Shropshire–Merino grades, produced seven lambs at about New Year's time. A warm pen having artificial heat was provided for the ewes at lambing time, and the feed for ewes and lambs was carefully recorded after the lambs were dropped. The ewes were fed oats, bran and oil-meal, 20:10:1, with clover, alfalfa, cabbage, roots and silage. By providing a lamb-creep, the lambs were fed, separately, bran, oats, corn meal and oil-meal, 4:2:2:1, and alfalfa hay. The lambs were marketed when seventy-five days old. They averaged 60.4 pounds per head, and returned a profit over and above the cost of feed for ewes and lambs, and of marketing lambs, of $6.43 per head.

Another method more commonly practiced than the above, is to carry the lambs until fall and sell them at a time when they otherwise would have to be housed. By feeding well-bred lambs continuously a small amount of grain, perhaps one-half pound per head daily, while on good pasture, it is possible to make them weigh close to one hundred pounds at the age of eight months at a comparatively low cost. To sow rape (*Brassica campestris*, Dwarf Essex variety) in corn or on ground specially set apart for it, and pasture it supplementary to grass, greatly assists in this method of fattening sheep.

A third popular method of fattening sheep for market is feeding native or western lambs and yearlings, beginning at about the ages of eight or twenty months, respectively. Corn is the principal grain, used in conjunction with clover or mixed hay, corn stover or other dry roughage. Oats are excellent at the beginning of the feeding period, since sheep like them and will eat them at once without harm. They produce little gain, however, and should be substituted by corn as rapidly as sheep will bear the change and continue to manifest a keen appetite, which is essential to insure good results. Peas produce excellent results, but are usually too expensive. Barley has been tried and produces fair returns, but will prove more satisfactory if mixed with other grains, as peas and corn. Some succulent feed, silage or roots, tends to keep fattening sheep healthier, and thus make better gains. Pea-straw and corn stover are next to alfalfa and clover hay as roughage for fattening sheep.

Cull ewes are usually marketed soon after shearing, when a sacrifice can be made, if necessary, on the amount they will bring for mutton. Using good, pure-bred rams, docking and castrating lambs at ten days to two weeks old, and giving them a good start, are factors to be emphasized in attempting to produce mutton.

Literature.

Mumford, The Production and Marketing of Wool, Bulletin 178, Michigan Agricultural College (1900); National Association of Wool Manufacturers, Annual Wool Review, Boston; Wisconsin Experiment Station, Twenty-third Annual Report (1906); Union Stock Yard and Transit Company of Chicago, Annual Live Stock Report (1907). [For further references, see page 596.]

The Feeding of Sheep. Figs. 609, 610.

By *John A. Craig.*

It is noticeable that the most successful shepherds are invariably quiet in manner, low-voiced and gentle in their ways. Sheep respond to such characteristics on the part of their care-takers more sympathetically than other classes of stock, and at no other time more than at the feeding hour. They are easily frightened and stampeded, and conversely, they are very trustful and dependent on those having charge of them. Boisterousness, coupled with rough usage and reckless driving in changing about from pasture to feed-lot, and any carelessness in management, are directly opposed to thrift and well doing.

It is necessary to see that the food and the troughs are clean. This requires that the troughs should always be cleaned before the sheep are fed from them ; and, furthermore, especially in the case of lambs, the troughs should have a strip along the top which will prevent the lambs crowding into the trough, or putting their feet into the feed. They dislike damp and muddy conditions, so that a clean and dry feeding-place is necessary. Sheep can stand almost any amount of cold, provided the quarters are dry and they are sheltered from wind. The latter not only materially interferes with their comfort, but also induces eye troubles under some circumstances. Regularity in feeding is imperative. Irregularity will make the sheep restless, which will retard their thrift and gain. Under most conditions, it will be advisable to feed sheep twice a day. The more the shepherd sees his

Fig. 609. Sheep-feeding scene.

sheep, and the more he is with them, the better they are likely to thrive.

When only a pound of grain, or less, is fed, it is hardly necessary to divide it into two feeds. The usual practice, unless self-feeders are used, is to feed the grain first, and then fill the racks. In this way the shepherd may follow the feeding more closely, for at no time is it easier to gauge the thrift of the sheep than when they are lined up at the feeding trough. It is often good practice to go among the sheep, and by feeling their backs make accurate note of their condition.

As a rule, it does not pay to grind grain of any kind for sheep, although this statement should be qualified when peas or beans are fed, for sheep do very decidedly better when these are cracked. In the case of young lambs, ground corn will give gains so much greater over the whole corn as to pay for the grinding. In the case of old ewes with lost teeth, it will pay too, although when feeding such, especially in the summer, soaked corn will give even more satisfactory results. It will likely prove profitable to shred or cut corn fodder, owing to the reduced waste ; but clover hay, pea-straw, oat hay and other forage of this class, may just as well be fed uncut. Roots may be fed sliced, more satisfactorily, as a rule. As accessories to successful feeding, the sheep need to have access to salt and water at all times. Some shepherds are of the opinion that water is not necessary where snow is abundant ; but clean, fresh water at all times certainly contributes to their well-being. It is a common practice to mix some sulfur with the salt, and this may be considered good practice for a few days at a time during dry weather.

Feeding lambs before weaning.

When a ewe has but a single lamb and she has an abundance of milk, there is no need of feeding the lamb any grain until near weaning time. In fact, some ewes give too much milk for a single lamb, and the latter may become too fat in the early stages of its life to secure the best ultimate results in health and thrift. When a ewe has two lambs, the latter are the better for getting some grain. It is generally advisable to feed some grain prior to weaning, so that when the lambs are being weaned they can be carried on without any check in growth or thrift because of the withdrawal of the mother's milk. It is very easy to teach lambs to eat grain before weaning by arranging a creep that they can go through into a small lot or section of the fold and get the grain without the ewes going through.

When the ewes are getting nourishing and succulent food, there is nothing gained by feeding them grain while they are suckling lambs ; hence, if any grain is to be fed, it should be given to the lambs direct. If the lambs are to be sold before weaning, or at that time, and it is advisable to have them then as fat as possible, it is necessary to begin feeding them grain as early as possible. When they are two weeks old, they may sometimes be induced to eat a little grain, but it is not likely they will do so until they are about a month old. The most satisfactory mixture, if rapid gains are desired, is, perhaps, a combination of three-fourths corn meal and one-fourth bran by weight. The lambs will take their time in beginning to eat, but soon after they start to eat this ration they will be eating one-fourth to one-half pound per head, daily. When they begin to eat it, it is well not to feed them enough to cloy their appetites. They should be given only what they will eat up clean, and always with a relish. If they are somewhat backward in eating after they have been started nicely, old feed should not be left in the feeding-trough, but regularly changed, so that the feed may not be stale at any time. Lambs intended for breeding

purposes, as a rule, do not require any grain until very shortly before weaning; then they should have it in order that they may not become checked in growth incident to weaning. The aim in feeding lambs intended for breeding purposes should be to keep them in nice flesh and splendid growing condition.

Feeding lambs after weaning.

To keep the lambs unchecked in growth after weaning, they should have the best of feed and care just at this time. It is well to have for them fresh pasture, or rape, or some other succulent feed which they like. If grain has been fed before weaning, the lambs have gradually become accustomed to grazing, and have relied more and more on the grain as the milk of their dams has dried up. So, when the lambs reach the weaning age, they are relying mostly on their own rations, and they will not miss the milk. It is advisable to remove the ewes as far as possible from the lambs, so that they will be encouraged to forget each other.

In addition to good pasture, or rape or some other green food, the lambs should be fed liberally on grain. Those intended for breeding purposes should get such food as tends to favor growth as well as condition, such as bran and oats, while those that are intended for market should be fed more fattening food. For these reasons it is well to separate the wether lambs from the breeding lambs. Again, the latter should be separated so that the ewe lambs are together and the ram lambs by themselves.

If the wether lambs are to be fattened for the early fall market, they should be given a liberal allowance of grain. There is no grain more fattening for lambs and wethers than corn. But to get the best results from it, some other grain should be fed with it, so that the appetites of the lambs may be sustained and the gain in flesh progress steadily. Bran is always a safe food to feed wethers, and it is always advisable to feed some of it, although it has never proved very fattening in any feeding experiments. The same is true of oats. They are both very wholesome and nutritious feeds, greatly relished by sheep. When it comes to making fat or gain, however, corn or cracked peas are the most satisfactory. Cracked corn and peas, with some bran, make a very superior ration for fattening. In feeding wethers that have already had grain, it is an easy matter to start them gaining quickly and sustain the increase; while some care is needed, yet there is seldom any danger, as in the case of feeding sheep unaccustomed to grain. Lambs fed grain before weaning will take a pound of grain daily, per head, after weaning, and make satisfactory gain on it, while, to feed lambs unaccustomed to grain that amount, immediately after weaning, would likely result in serious loss.

When the lambs are being fed so that they may go on the market fat, sometime during January or thereabouts, they do not need such rapid crowding during the fall months, for it is easy to get mature lambs too fat and heavy for the highest market price per pound. It is a fact that the general market prefers a fat lamb of one hundred pounds or under to one that is over that weight, provided the condition as to fleshiness is the same. For fattening mature lambs during the fall season, there is nothing better than good grass pasturage and rape or rutabagas, with a mixture of grains, such as corn and oats. The grass pasture should be used to turn the lambs on in the morning before they are permitted to go on the rape. If the lambs get a small grain ration, too, in the morning, before being permitted to graze on the rape, there is very little danger from bloating. This grain ration may consist of bran and corn or oats and corn, half and half by weight.

After the season for rape and roots and pasture is passed, the wether lambs being fattened should be penned or yarded. They apparently do better

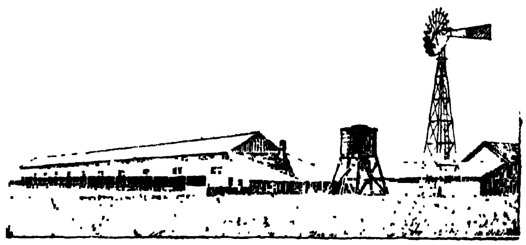

Fig. 610. A sheep-feeding shed in Utah.

when limited in range at this time. A nice, dry yard adjoining the feeding-pen is very desirable to turn them in. In the North, fattening lambs need dry shelter but do not need to be closed in so as to be warm. Dryness, with free ventilation of the quarters, are the main considerations. In the South, it is advisable to have a corral on a high dry site, where the lambs can be put during feeding time and at night. A woven wire corral, dog and wolf proof, is a necessity under such conditions. In the South, the lambs can be allowed to run on rape or turnips during the greater part of the winter season, and fed dry fodders only a short time before shipping, so that the shrinkage may be reduced. In the North, fodder-feeding becomes a necessity during the yard-feeding, although such foods as wheat screenings, or others in which there is considerable chaff or roughage, may be fed alone. Both dry and succulent fodder, with some grass, will give the best results. Of the dry fodders for fattening, it is hardly likely that any will surpass alfalfa or the clovers. For succulence, corn silage or roots are very satisfactory, while for grain, corn, oats and bran and, perhaps, some oil-meal or cottonseed meal, if not too high in price, may be used to advantage. The lambs, when put in the feeding yard or pens, should be taking about a pound per head daily of the oats-and-corn mixture. This should be increased gradually. Highly bred mature lambs, accustomed to grain all their lives, will ultimately take two and one-half to three pounds of grain per head daily when they are ripe for market or show; but, of course, this high feeding cannot be continued long. They

will make corresponding gain on it, thus showing what careful training in feeding will do, coupled with inherited fattening tendencies. The lambs need just enough exercise in the yards to keep them strong and sound on their legs; more than this or any excitement tells in reduced gain.

Referring back to the breeding lambs, they should have a run of rape and pasture and have some oats and bran, although, if they keep in good growthy condition without the grain, it would be good economy to withhold it. By keeping the ewe lambs growing steadily and feeding them nourishing fodders during winter, such as clover hay, corn fodder, and some oats or bran during the winter, they grow into good large yearlings and clip a surprisingly heavy fleece in the spring.

The ram lambs should also have an abundance of nourishing food,—clover hay, oats, roots and such foods as tend to encourage growth and flesh rather than fat. Both the ewe lambs and the ram lambs should have abundant exercise. This may be encouraged in the North by feeding them their fodders some distance from the sheds, and thus inducing them to take exercise to get their feed.

Short fattening period.—The majority of the lambs that go on the fat market have had a short fattening period of three to four months. Western lambs, or those from the ranches, are fed in this way. In feeding these lambs, the first point to remember is that they have never had any grain,—nothing except grasses. To feed such lambs on the farm, it is advisable to get them comparatively early in the season, unless the market is not favorable for purchasing. When they are brought on the farm early, they may do a great deal of good in cleaning up stubble corn-fields, weedy pastures and the like before the feeding begins, provided the fields are free from burs. For such lambs there is nothing better than a month or so of preparatory feeding on rape or roots, as it puts them in sappy and thrifty condition. They need to be managed very carefully while becoming accustomed to the rape. Of all things, they need most the run of a pasture before being turned on the rape, and when on the latter, they should be hurdled; that is, a temporary fence should be used in such a way that the lambs get only a limited amount of rape. For grain, bran or oats is about the safest feed to begin with. At first, put about one-fourth of a pound per head daily in the trough. As soon as they realize what the grain is for, they will be anxious for more. Whether the grain should be increased rapidly or very slowly will depend greatly on the quality and previous feeding of the lambs. At any rate, it is always safest to increase the quantity slowly. At the end of two weeks, they may have one-half pound per head daily, and by the end of a month, one pound per head daily will be about as much as they should have. When this quantity is reached, make the grain ration one-half corn and one-half bran or oats by weight, and feed this mixture in two feeds, one in the morning and the other in the afternoon. For fodder, feed clover hay, cornstalks, or pea-straw, varying the ration according to the foods available.

At the end of three months of careful feeding, the lambs will be taking one and one-half to two pounds of grain, and about two or three pounds of clover hay, according to the quality and their relish for it. A pound and a half to two pounds per head per week may be considered to be the range of gain in live weight from such feeding. A western lamb weighing fifty to sixty pounds when purchased may be expected to weigh eighty to ninety pounds at the end of three and one-half months of feeding, provided the lamb is of a smooth, thrifty type, and continues to do well on such feeds as those mentioned.

Feeding breeding ewes.

While sheep will eat a wider range of weeds and other plants than other classes of stock, yet they show very decided preferences for some fodders. To carry breeding ewes over winter successfully, in the North, it is very necessary to know their likes and dislikes. Breeding ewes, and, in fact, all classes of sheep, have a decided liking for clover hay, and the finer it is in leaf and stem the cleaner they will eat it up. For this reason, alfalfa and alsike are greatly liked, although second crops may surpass either of these. Pea-straw, shredded corn fodder and oat hay are good. The fodders may be fed some distance from the fold so that the ewes are forced to take some exercise. A mutton grade ewe, weighing 100 to 150 pounds, will eat two to three pounds of these fodders daily during the winter season. If the breeding ewes have had good grass in the fall, they will have gained in flesh after the weaning of the lambs, and they are not likely to need any grain unless just at breeding time. They should certainly have some oats if the pasture has not been sufficient and they have not received any rape to supplement it. The ewes should go into winter in strong condition. It is advisable to corral them and handle their backs, to be satisfied on that point, although most shepherds can tell by a ewe's appearance as to whether or not she is thrifty enough.

As lambing time approaches, the ewes should be fed liberally on a variety of roughage. Some succulent food, such as corn silage and roots, is thought to induce a free flow of milk. As soon as the ewes lamb, they should receive some grain. Wheat bran and oats are very satisfactory. Corn may be fed in moderation, but it cannot be considered as wholesome a food for breeding ewes as bran or oats. If the ewes lamb about the time grass is ready for them, there will be no need of feeding them further on grain, although, if the grass is very lush and immature, some grain may be fed profitably. Frequent change of pasture, with some rape cut and fed, should keep the ewes milking well. They may become thin, but it is not advisable to feed them grain if the succulent feed is available and the ewes remain in good condition.

Feeding rams.

In the feeding of ram lambs, there is no grain more satisfactory than clean heavy oats. The ram lambs should get oats from weaning time. This,

with good pasture, will be all that is necessary until winter. Then clover hay and corn fodder, with roots or silage, should constitute the ration. The ram lamb should be given little service, if any. A ram lamb that was born very early and has made an uninterrupted growth, and has been fed well, may be used for service as a lamb, but as a rule it is best to delay until a year old. During the winter the ram lambs should be run together. They should get their fodder outside, so that they are made to take as much exercise as possible.

During the breeding season, a ram requires extra attention, especially in feeding. Bran and oats are splendid foods, and these should be fed liberally if necessary to maintain the ram's condition. A ram in good condition, with firm flesh, will prove more satisfactory as a breeder than one over- or under-fed. To secure such condition, experience teaches that the most effective method is to include liberal feeding on clover hay, roots and oats, coupled with abundant exercise.

Literature.

For references, see page 596.

Determining the Age of Sheep.

By *H. H. Wing.*

Sheep have two sets of incisor teeth, on the lower jaw only. The first or middle pair of temporary teeth is replaced by permanent ones when the lamb is thirteen to fifteen months old, and thereafter the succeeding pairs of permanent teeth appear at intervals of a little less than a year. Most shepherds reckon a year for each pair, so that, when the last pair is fully up and in wear, the sheep is four years old. As age advances, the teeth grow narrower and slimmer until advanced age, eight or nine years, when they often shorten rapidly from wear and finally disappear. So long as the teeth remain strong and fairly firm, the sheep may be said to be in good working condition.

Common Ailments of Sheep. Figs. 611–614.

By *Louis A. Klein.*

We may group the ailments of sheep that are to be discussed in this connection under three general heads: (1) Diseases caused by animal parasites; (2) bacterial diseases; (3) non-contagious diseases. It is possible to consider here only the more common ailments that come under these three heads.

I. Diseases Caused by Animal Parasites

The diseases that are most common among sheep, and that are of the greatest economical importance, are caused by animal parasites — worms, flukes, ticks, mites, lice, grubs. Because of their smaller size and strength and, to a less extent, their habit of cropping forage close to the ground, sheep are more vulnerable to the attacks of these pests than the domestic animals of other species; while the custom of keeping them in flocks favors the reproduction and development of the parasites. Lambs are more susceptible than older sheep. The warm season of the year is the most favorable period for the development of the parasites and the infestation of the sheep, which fact explains why these diseases are more severe in the warmer sections of the country; but the symptoms of disease do not usually appear until late summer or in the fall. Low-lying wet pastures, and those with a retentive soil or with a clay subsoil near the top, supply conditions favorable to the development of the parasites. Keeping sheep continually in the same lot or pasture also assists in the propagation of the parasites, and the smaller the pasture in comparison with the size of the flock, and the longer it is used, the more severely will the sheep suffer from these diseases.

Stomach-worm disease.

This is the common name for a condition which occurs when the fourth stomach is infested with a large number of thread-like worms (*Hæmonchus* or *Strongylus contortus*, Fig. 611) one-half to one inch long, of a whitish color with a red spiral running through the body like a cork-screw. The infested animals are unthrifty, dull, and gradually lose flesh and strength. After a time, a soft, non-inflammatory swelling appears under the jaws and diarrhea develops. Thirst is increased. The appetite for food may be diminished or it may continue to the end, the animals eating after they are too weak to stand. The eggs of the worms pass out with the manure and young worms hatched from them are swallowed by sheep and cattle feeding on infested ground. In this way the disease is transmitted from one animal to another.

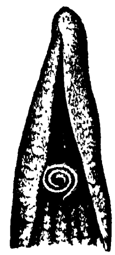

Fig. 611. Embryonic stomach worm on grass blade.

Treatment.—Changing the flock to high, dry, well-drained land which has not been occupied by sheep for at least a year, feeding generously and providing plenty of salt, will bring about an improvement and usually stop losses, although it will not save those animals that are in the advanced stages; and, if the sheep are moved from time to time to other lots or pastures, the improvement will continue. No drug or combination of drugs can be absolutely depended on to remove the worms from the sheep, but good results may be obtained with coal-tar creosote or gasoline. Ten drams of coal-tar creosote are shaken up in a gallon of water, and of this mixture four to six tablespoonfuls are given to lambs, and eight to ten tablespoonfuls to yearlings and older sheep, every other day until three doses have been given. The mixture should be well shaken before measuring out each dose. The gasoline is given in milk, raw linseed oil or flaxseed tea, two teaspoonfuls for lambs and one tablespoonful for sheep daily, for three successive days, each dose being measured and mixed separately. The sheep should have no feed for at least twelve hours before the medicine is given, and no feed or water for at least three hours after. All the sheep in the flock should receive treatment.

Medicines intended to operate in the fourth stomach or in the bowels are most effective when given in a liquid, being poured slowly into the mouth from a bottle, with the sheep standing in a natural position and the head slightly elevated. Those who may prefer the easier but less effective method of giving medicine with the feed can use: Arsenious acid 1 dram, sulfate of iron 5 drams, powdered nux vomica 2 drams, powdered areca nut 2 ounces, common salt 4 ounces; mix thoroughly, divide into thirty doses and give each sheep one dose daily in ground feed for ten days.

Eradication of the worms from infested lots or pastures has been attempted in several ways. Burning off the grass in the spring or fall has proved effective. Keeping sheep out of a pasture will not cause the worms to die out unless cattle are also excluded for at least a year.

Nodular disease.

Nodular disease is characterized by the presence in the wall of the intestines of tumors or nodules, in which is found a miniature worm about one-eighth of an inch long, which is the cause of the disease. This is the larval stage of the *Œsophagostoma columbianum.* The fully developed worms are one-half to three-fourths of an inch long, and are found attached to the inner lining of the large intestines. The eggs and worms pass out with the manure, and the pastures or feeding lots, and pools receiving the surface drainage from them, become infested.

Lack of condition may be the only indication of the disease. When the infection is more extensive the sheep is dull, weak and thin, the wool dry and the eyes and lips pale. In severe cases there is rapid emaciation and diarrhea.

Treatment.—The entire flock should be removed from the infested pastures to land that has not been used by sheep for at least eight months, should be given as much range as possible, and should be shifted about as often as conditions will permit. A plentiful supply of salt, with some grain in addition to the grass, would also be beneficial. Water free from infection should be provided. Much can be accomplished in this way in repressing the disease even if it is not eradicated, especially if the sheep are placed on high, dry land. If practicable, each sheep should receive a dose of thymol, thirty to forty-five grains, shaken up in water or in the coal-tar creosote solution prescribed for stomach worms, before the flock is removed to the clean pasture. Repeat in a week or ten days. The greatest benefit will be derived from the medical treatment, if the sheep are removed in about a week or ten days from the inclosure in which they are placed after treatment, to another clean pasture.

Tape-worms.

Two species of tape-worm are found in sheep in America, the fringed tape-worm (*Tænia fimbriata*) and the broad tape-worm (*Tænia expansa*). When fully developed, the fringed tape-worm is six to twelve inches long and consists of a head and a large number of small joints or segments; but in the immature form in which it is swallowed by the sheep, it is only one-fifth of an inch in length. The broad tape-worm also consists of a head with many joints or segments attached, and is found only in the intestines. It attains a length of five yards and grows very rapidly. The segments or joints at the end become separated and pass out with the manure, and, as these are filled with eggs or embryos, pastures are infested.

The indications of infestation develop slowly. Unthriftiness is usually the first sign. Later, there is gradually increasing weakness and loss of flesh, the flanks are drawn up or distended with gas and the gait is unsteady. The appetite for feed and water is often increased, or preference is shown for unusual substances. In cases of extensive infestation, the weakness and emaciation is extreme and there is pronounced diarrhea. Segments or joints of the worms may be observed in the bowel discharges.

Treatment.—Sheep that do not show symptoms of infestation should be removed to a pasture or lot which is not infested and provided with clean drinking-water, fed well, given plenty of salt, and provided with sufficient protection against severely cold weather and storms. Those that are visibly affected should be cared for in the same way, and if they can also be placed on land free from the worms it will be advisable to do it. The pastures should not be overcrowded, and the sheep should be moved frequently from one pasture to another. Planting forage crops will greatly facilitate the change to fresh feeding-ground at frequent intervals.

Drugs are of little or no value in combating the fringed tape-worm, as it is not possible to reach the worms in the bile ducts; but when the broad tape-worm is present, every sheep in the flock should receive one-half to one dram of the extract of male fern in two to four ounces of castor-oil, or one to one and one-half drams of kamala. They should have no feed the night before, nor on the morning of the day on which the medicine is to be given, and they should receive no water for five or six hours after treatment. Feeding pine sprouts is recommended; also pumpkin seeds, twenty to thirty seeds to each animal.

The species of tape-worm present can be determined by making a post-mortem examination of one of the most seriously affected sheep. Pastures that are badly affected with the fringed tape-worm can be most economically cleaned by excluding sheep and using them for horses and cattle until the worms die out. Where the broad tape-worm is present, cattle must also be excluded, as this worm infests cattle as well as sheep.

Fluke disease or liver-rot.

This disease is caused by flat, leaf-shaped parasites (*Distomum hepaticum, D. lanceolatum* Fig. 612) which, after having been swallowed with the food or water, migrate to the liver and destroy the substance of that organ. The eggs deposited by the flukes are carried out with the manure, but the embryos that are hatched from them must pass a period in certain snails (*Limnæus truncula-*

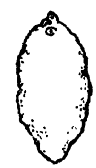

Fig. 612. Common liver fluke. Natural size.

tus s. *minutis*), and another stage in the water before they are capable of infesting sheep. Damp, swampy pastures and stagnant pools of water furnish the conditions favorable to the development of the parasites.

Lambs and yearlings and sheep of feeble constitution suffer most readily. The symptoms of the disease do not appear until the damage to the liver is extensive—about one and one-half to two months after infection. Then, there is a rapid loss of condition and weakness; the wool becomes dry and may drop off; the eyes and lips become bloodless and puffy swellings may appear around the eyelids, under the jaw and along the brisket; the appetite is poor, or unusual substances may be eaten; the bowels are irregular, constipation alternating with diarrhœa.

Treatment.—Preventive measures are of more value in combating the disease than medicinal treatment, as the flukes are so located that drugs cannot operate on them with sufficient effect, and, in those sheep showing symptoms of infestation, the changes in the liver are too extensive to be repaired by drugs. The sheep should be removed to high, dry pastures, the sick being separated from the well; they should be given nourishing food with a plentiful supply of salt. Infested pastures and pools should be drained and should not be used by cattle or sheep for a time. As snails are essential to the development of the flukes, their destruction will assist in the eradication of the parasites. Frogs, toads and carp have been used for this purpose with good results. The introduction of carp into the Willamette and Columbia rivers was followed by a great decrease in fluke disease in sheep pasturing in slough lands along the lower parts of those streams.

Gid, sturdy, staggers, turn-sick (Fig. 613).

The most prominent and characteristic symptoms of this disease are the peculiar, unconscious and uncontrollable movements of the victims—moving in a circle, twisting or turning as on a pivot, swaying and reeling, running straight forward with the head elevated, and the like. It is caused by the presence in the brain or spinal cord of the gid bladder worm (*Cœnuris cerebralis*), the cystic or bladder stage of one of the tapeworms infesting the dog (*Tœnia cœnuris*). The eggs are scattered by the dog on the grass or in the drinking places, and the embryos that are hatched from them when they are swallowed by sheep migrate in some manner to the brain or spinal cord. This period of migration lasts eight to ten days and is attended in some animals with little or no disturbance, while others are more seriously affected, depending on the number of parasites. There may only be some depression, a clumsy gait or stupidness. When the infestation is more extensive, the head is hot, the eyes red, the head is held in a peculiar position, and the animal may run aimlessly about, turn in a circle, press to one side, or stagger. Death may occur in four to six days, but usually the symptoms subside when the embryos have established themselves in the brain or spinal cord, to reappear in four to six months when the bladders have reached a sufficient size to seriously affect the functions of these organs. The animal will stop eating suddenly without any apparent cause, there is dullness and weakness, the eyes are glassy and staring, sight is lost, and the uncontrollable and unconscious movements referred to above occur at intervals several times during a day.

Fig. 613.
Skull of sheep, showing brain infested with gid bladder-worms.

Treatment.—It will be found most economical to slaughter infested animals when the first symptoms of the final stage appear, and while they are still in good flesh. Preventive measures are very important. Carcasses of infested sheep should be disposed of in such a manner that the brain or spinal cord cannot be eaten by dogs; and the dogs on the place should be treated at regular intervals for tape-worms. This treatment should be given as follows: the dog should receive one to two tablespoonfuls of castor-oil to empty the bowels, and should receive no food for a day except a little soup or milk. The next morning, fifteen to forty minims of extract of male fern should be given, followed in two hours with a tablespoonful of castor-oil. During the course of treatment the dog should be kept tied up, and the bowel discharges should be buried in quicklime or burned.

Grub in the head.

This is a disease of the cavities of the nose and sinuses of the head, which is caused by the larvæ or grubs of the sheep gadfly (*Œstrus ovis*). On the appearance of the flies the sheep become greatly excited, and seek to protect themselves by thrusting their noses between the fore-legs, holding their heads close to the ground, or by crowding together in a circle with heads depressed. If larvæ are deposited about the nostrils they shake their heads, run about and rub their noses against their fore-legs or any object that may be accessible. No symptoms of disease appear until the following spring, when the larvæ begin to emigrate. Then a nasal discharge occurs, which is sometimes bloody, and there is also considerable sneezing and snorting, during which larvæ are often cast out. These are three-quarters to one inch long and of yellowish brown color. There is also shaking and swinging of the head and rubbing of the nose; the eyelids are often swollen and there is a discharge of tears; sometimes the brain is also affected and then there is dullness, fits of dizziness, an unsteady gait, or convulsions.

Treatment.—It is possible to open the sinuses with a trephine and remove most of the larvæ, but this method of treatment is not available to the average flock-master. Injections are of no value as they cannot be used in sufficient strength to destroy the larvæ without injuring the membranes of the nasal cavities and sinuses. All animals

severely affected should be sent to market; the others will recover as soon as all the larvæ have emigrated. All larvæ found on the ground should be destroyed and the heads of any infested sheep that may be slaughtered should be disposed of in a manner that will destroy the larvæ. Where the gadfly abounds, the noses of the sheep should be smeared every three or four days during the swarming season with a mixture of equal parts of tar and grease, or tar and fish-oil, or tar and whale-oil. Another method of prevention is to plow a furrow in the pasture to give the sheep an opportunity to bury their noses when the fly approaches.

Hoose, husk, paper-skin, lung-worm disease.

These terms are used to designate a disease of the lungs and bronchial tubes produced by two species of parasites, the thread lung-worm (*Strongylus filaria*) and the hair lung-worm (*Strongylus ovis-pulmonalis*). The thread lung-worm is one-half to two inches long and is found in the bronchial tubes. The hair lung-worm is much smaller, two-thirds to one inch long and of the diameter of a hair, and is found in the air cells and lung tissue.

Infested sheep do not show any signs of disease until many worms are present and extensive changes have occurred in the bronchial tubes and lungs. The most prominent symptom is a cough, which occurs in fits or spasms, leaving the victim almost suffocated. During these coughing spells the worms are ejected and scattered about, and as these discharges contain the embryos, food and water contaminated in this way become infectious. There is also a discharge from the nostrils in which the young worms and fragments of old worms can likewise be found. In the later stages, the skin is dry and harsh, whence the name paper-skin; the wool is dry and can easily be pulled out; the eyes and lips are bloodless and there is loss of flesh and gradually increasing weakness. The appetite is fair in the beginning but later it may disappear entirely.

Treatment.—It will be best for the flock in which this disease appears to send all the sheep which seem to be most infested to market, unless they are of value for breeding purposes, or unless the disease has advanced so far that they are weak and emaciated; in any case, they should be separated from the flock, as they are a source of infection to the others. The entire flock should be removed to non-infested enclosures and given nourishing feed, plenty of salt, and water free from the parasites. Lambs should be weaned as soon as possible, and placed in a pasture or lot which has not been occupied by sheep since the previous winter at least. Injections of vermicides into the wind-pipe, either in solution or in the form of a spray, have given good results in the treatment of sheep infested with the thread lung-worm, but these methods are not available to the ordinary flock-master. A more simple method of treatment is fumigation. To carry this out, it is necessary to have a tightly-closed room in which to place the sheep. A mixture of flowers of sulfur and alcohol in a deep dish or pan floating in a vessel of water is then placed in the room; the alcohol and sulfur is ignited, and the door closed. Some one should remain in the room with the sheep, or they should be closely watched, so that they will not be suffocated. A mixture of one part of salt to twenty-five parts of copperas is also advised, to be kept constantly before the sheep. For the eradication of the worms from infested lots or pastures, the same methods can be used as for stomach worms.

Scab. (Fig. 614.)

Scab is an itch or disease of the skin caused by a species of mite (*Psoroptes communis*) just large enough to be visible. These little insects bite the skin to obtain food, and the irritation or itching thus produced causes the sheep to scratch, rub and bite the infested places; little blisters form where the mites bite, and the rubbing, scratching and biting of the sheep inflames the skin, which becomes red, thickened, hot and tender. The blisters rupture and the yellowish liquid they contain, drying on the skin with the sweat and dandruff, forms the yellowish-brown scab from which the disease takes its common name. The wool becomes "tagged" or glued together in tufts and finally falls out, exposing the rough, dry, scab, which may be full of cracks or fissures and ulcerations. The disease is very contagious from one animal to another. Tags of wool from infected sheep, fences or posts against which scabby sheep have rubbed, sheds or buildings occupied by them, or old bedding may harbor the mites and convey the disease to healthy sheep. The common variety of scab affects the back, sides, rump and shoulders. The other varieties—head scab or black muzzle, foot scab and follicular scab—occur very rarely in this country. Itching caused by ticks and lice, inflammation of the skin glands, and rain-rot have been mistaken for scab; but such mistakes will not occur if the mange mite is always searched for in the edges of the scab.

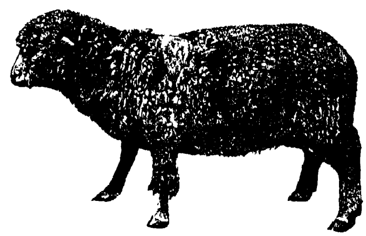

Fig. 614. A case of sheep scab.

Treatment.—When scab appears in a flock, all of the sheep should be sheared and confined to one part of the farm or in a certain pasture for two to four weeks, after which each animal should be "dipped" in a mixture that will kill the mange mites, and returned to the same part of the farm, or to the same pasture. Seven to ten days later they should be "dipped" again, and then placed in that part of the farm or pasture from which they have been excluded since shearing. The lime and sulfur dip is one of the most satisfactory mixtures for treating scabby sheep. It is made as follows: To eight to eleven pounds of unslaked lime add enough water to slake to a paste; sift into this paste exactly three times as many pounds of flowers of sulfur as of lime used, weighing the sulfur and

lime accurately; place the mixture in a boiler, add twenty-five gallons of water, and boil for at least two hours, stirring frequently; allow the sediment to settle, and then dip off the fluid and add enough water to make one hundred gallons. While using the dip, it must be kept at a temperature of 100° to 110° Fahr., the temperature being determined by a thermometer. Each sheep should be kept in the dip for two minutes by the watch, the entire body being covered with the liquid, and the head immersed at least once. When only a small flock is to be treated, an ordinary kettle may be used for preparing the dip, and a wash-tub for the dipping; but when large numbers of sheep are to be dipped, involving much work, special apparatus will be found most economical.

Sheep ticks.

The sheep tick, which is really not a tick but a wingless fly with a leathery, bristly, flattened body about a quarter of an inch long, inhabits the fleece of the sheep and bites the skin at intervals to suck blood. When the ticks are few in number, they have little effect on the sheep, but when they are numerous the itching and pain caused by the bites of the insects keep the sheep biting and scratching most of the time, affecting their general condition. Lambs suffer most severely.

Treatment.—Dipping the flock in the lime and sulfur mixture or in a kerosene emulsion will rid them of the parasites. The kerosene emulsion is made as follows: shave a pound of soap into a gallon of water and dissolve by boiling, add two gallons of kerosene and churn or mix until the oil is "cut" or emulsified; use one gallon of the emulsion to eight of water. It is best to dip twice, with an interval of two weeks, and to keep the sheep out of the old pens or pastures for a week. The pens and other resting-places should be scraped out and cleaned.

Sheep lice.

The sheep louse is very small, only one twenty-fifth of an inch in length, with a reddish head and whitish body. Itching is a symptom of the presence of this parasite, which also causes the skin to become thickened, rough, and covered with small black scabs, while the wool covering these places becomes short, dry and twisted. Infested flocks should be dipped in the kerosene emulsion.

Maggots.

Maggots are sometimes found in wounds on sheep. These are the larvæ of a fly (*Lucilia macellaria*) that is common in America, especially in the warmer sections, and that is to be recognized by its blue body, streaked with darker blue or purple bands. The fly deposits its eggs on the wool or in the wounds or sores, and when the larvæ are hatched they burrow into the diseased tissues, causing much distress to the sheep. Flowers of sulfur and benzoated lard, mixed in equal parts, or oil of tar, applied to the diseased areas will destroy the maggots and also prevent the fly from depositing eggs.

II. Bacterial Diseases

For information concerning those contagious or infectious diseases which affect sheep as well as the domestic animals of other species, the reader is referred to the article on *Infectious Diseases of Animals*, pages 124–146.

Foot-rot.

Foot-rot usually begins in one foot and subsequently attacks one or more of the others. Lameness is the first indication of the disease, and when the foot is examined a red, moist spot is found in the cleft just above the horny part. The disease extends beneath the horn, and in a short time there is a thin, sticky discharge of a disagreeable odor from a hole in the horn. The region above the hoof becomes swollen, hot and tender. If the disease is neglected, a large part of the horn is undermined and loosened, and the extension may continue until even the bones are affected. During warm weather, maggots may attack the affected parts. The disease is caused by a germ (*Bacillus necrophorous*), which exists in large numbers in the discharge from the diseased feet, and healthy sheep placed on ground or in sheds contaminated with this material are liable to contract the disease. Contagious foot-rot should not be confused with *foul-foot*, which results from muddy lots or marshy pastures, or from wounds from sharp stones and the like; or with the swelling, suppuration and lameness that occurs when the opening of the little oil gland in the cleft of the hoof is choked up with mud or sand.

Treatment.—When the disease is discovered, the feet of the healthy sheep should be treated with a solution of one pound of chlorid of lime to each twelve quarts of water, or one pound of carbolic acid crystals to each four gallons of water, after which they should be removed to uncontaminated lots or pastures. When the flock is large, the solution may be placed in a wooden trough about six feet long, twenty inches wide and one foot deep, the solution being about four inches deep, and the sheep made to walk through it slowly. The diseased sheep should be treated as follows: Cut away all loose or undermined horn and all proud flesh, and stand the animal for ten minutes in a solution containing four pounds of copper sulfate in each five gallons of water, applying a soft bandage when deep cutting has been necessary. When the disease has extended into the deeper parts, the affected area should be carefully washed with a solution containing one ounce of carbolic acid crystals in twenty ounces of water, then dusted with a powder consisting of equal parts of boric acid and oxid of zinc, and covered with a soft bandage. After treatment is begun, the diseased sheep should be placed in lots or pastures free from infection.

In order to prevent the introduction of the disease, sheep purchased for addition to the flock should be kept under observation in separate quarters for a few days. Keeping the feet of the sheep properly trimmed will assist in keeping the cleft of the foot free of dirt and help to prevent the

spread of the disease. Pastures occupied by diseased sheep can be used safely for healthy sheep the following spring, but infected lots and sheds should be thoroughly cleaned and disinfected.

Sore mouth and feet.

The contagious foot-and-mouth disease of Europe does not exist in this country, but sheep are sometimes affected with an ulcerative condition of the mouth and feet that is often referred to by this name. This disease, which is caused by the *Bacillus necrophorous*, does not spread from animal to animal like the true foot-and-mouth disease, but certain lots, pastures or sheds become infected with the germs, which enter the tissues when the mouth or foot is injured by stiff, brittle forage or briars, and set up the disease. Ulcers appear in the skin of the leg above the hoof, and in the membrane lining the lips. If the disease is neglected, these ulcers may spread over a large area and extend deep into the tissues; the ulcers may also appear on the face. When the feet are affected there is lameness, while disease of the lips is accompanied by an interference with feeding.

Treatment.—Removing the scabs or shreds of tissue from the diseased areas and washing them twice daily with a solution of one tablespoonful of creoline in a quart of water, then painting with Lugal's solution of iodine, will result in a complete cure, if treatment is begun in time. In using the latter solution on sores in the mouth, care should be taken to confine the application to the diseased places. Infected lots and sheds should be cleaned and disinfected.

Sore mouth may also result from the sheep feeding on grains or grasses affected with fungi and other vegetable organisms, a condition which may exist in wet seasons. Blisters or ulcers are seen on the membrane lining the mouth and lips, and the breath may have a sour odor. These blisters and ulcers sometimes occur on the teats of the ewes, and lambs suckling them suffer an attack of the mouth disease. The treatment consists in changing the feed, washing the mouth with a solution containing a half ounce of boric acid to a pint of water, and afterward placing a little powdered alum on the tongue. Affected teats can be treated with the same drugs. Sore mouth has occurred in sheep fed on wheat screenings rich in mustard seeds, and ulceration of the gums and jaw-bones has occurred from the barbed awns of squirrel-tail grass.

Malignant catarrhal fever.

This disease usually affects a number of sheep simultaneously. There is a discharge from the nostrils; the eyelids are swollen and may be stuck together with a greasy matter; in addition, there is a cough, rapid breathing, constipation or diarrhea, and loss of appetite.

Treatment.—Sheep that are severely affected should be slaughtered, and the healthy animals should be separated from those slightly affected. The sheds occupied by the diseased animals should be cleaned and disinfected. The entire flock should be given nourishing feed and each sheep should receive a tablespoonful of the following tonic mixture in the feed twice daily: Powdered nux vomica 3 drams, powdered sulfate of iron 3 ounces, powdered gentian root 4 ounces, powdered potassium nitrate 1 ounce, linseed meal 8 ounces, mix thoroughly.

III. Non-contagious Diseases

Wool-eating.

Wool-eating is regarded as a habit and also as an indication of a deficiency in certain food elements. As a rule, the general health is not affected, but, when the vice is practiced excessively, wool is swallowed in such quantity that digestion is disturbed, and there is loss of condition. The affection usually develops during the winter, when the sheep are confined and are being fed on dry feed, and disappears when they are turned out to pasture.

Treatment.—Wool-eaters should be immediately separated from the flock, and there should be a change of feed, especially of the hay or roughage. The feeding of corn often has a good effect. A generous ration should be fed, and the following should be mixed with the ground feed, one teaspoonful being allowed for each sheep in the flock: Powdered gentian 4 ounces, common salt 8 ounces, bicarbonate of soda 4 ounces, and sulfate of soda 4 ounces. Some veterinarians have used with great success hypodermic injections of apomorphine, one and one-half grains daily for three successive days. Lambs usually begin the practice of the vice by gnawing the soiled "tags" of wool about the udders of the ewes, and for this reason trimming the udders has been recommended.

Bloating.

Bloating usually occurs when green corn, rape, clover and other succulent plants are eaten by sheep unaccustomed to them, or when these plants are consumed in unusual quantity; the condition is especially liable to occur if the plants are wet from dew or rain. Drinking cold water in large amount immediately after eating, and frozen feed, are other causes. The digestive processes of the paunch are deranged and the material in this organ ferments, forming gas. The abdomen becomes swollen or bloated, especially on the left side, and emits a drum-like sound when struck with the fingers; feeding and rumination ceases, there is dullness or depression, and breathing is difficult. Usually a number of sheep are affected, and prompt action is necessary to save them from suffocation.

Treatment.—Relief can be afforded most quickly and certainly by letting the gas out of the paunch with a trocar and canula; if one of these instruments is not available, a knife may be used, but the blade should be clean. Following the operation each sheep should receive a tablespoonful of baking soda dissolved in a half pint of warm water to check the fermentation. Driving the sheep into a stream will often cause the expulsion of the gas. After the acute symptoms have subsided, each animal should receive the following dose: Sodium sulfate 3 ounces, powdered Jamaica ginger 2 drams, tincture of nux vomica ½ dram, water 1 pint.

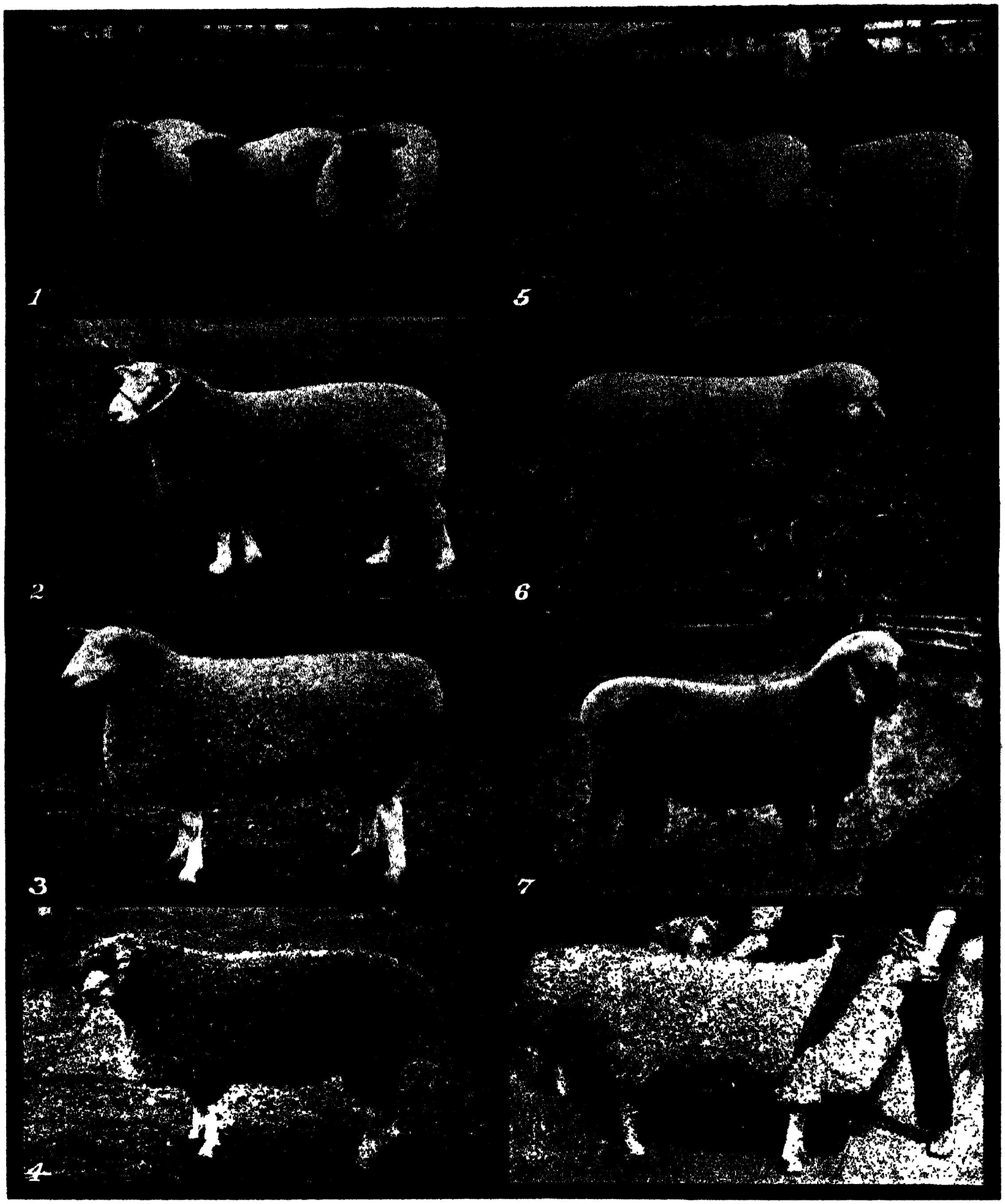

Plate XXII. Breeds of long-wool sheep

1. Oxford Down ewes
2. Romney Marsh ram
3. Border Leicester ram
4. Lincoln ram
5. Shropshire ewes
6. Shropshire ram
7. Hampshire ram
8. Cotsweld

Bloating may also occur in choking. In such cases it will disappear with the removal of the obstruction in the gullet.

Scours.

The chief sign of this disease is a diarrhea, the foul-smelling discharges soiling the tail, hips and legs; the appetite is lost; the abdomen is distended; there is abdominal pain, which is manifested by restlessness and switching the tail; gradually increasing weakness and emaciation follow. In sucklings, the condition results from faulty feeding or mismanagement of the ewe, or is due to a contagion that enters through the navel cord immediately after the lamb is dropped. In the latter case, the lambing pens must be thoroughly cleaned and disinfected, and as soon as the lambs are dropped the stump of the navel cord must be washed with a 5 per cent solution of carbolic acid and then painted with tincture of iodine. Overfeeding, sudden changes from dry to green feed, cold and damp quarters, are some of the causes of the condition in weanlings. In these cases, two teaspoonfuls of castor-oil containing two or three drops of creolin should be given at once, and followed with a tablespoonful of the following mixture three times daily: Paregoric 1 dram, sherry wine 3 drams, subnitrate of bismuth 2 drams, salol ½ dram, mucilage of acacia 5 ounces. Attention should also be given to the feeding, and clean, dry, sunny quarters provided.

Grass staggers.

Grass staggers is a term used to describe chronic catarrh of the stomach and intestines when it is associated with a staggering gait, restlessness, delirium, running into objects, drowsiness, or other symptoms of nervous derangement. The condition sometimes occurs when dry, woody, and innutritious feed is eaten in large amount with insufficient water; when sudden changes of feed are made repeatedly; and when rich concentrates are fed in excess, and the roughage or bulky feeds are insufficient. Millet hay rich in seeds has also caused it. Usually, the disease develops slowly. At first, there is only diminished appetite and irregular rumination; then, constipation, abdominal pain, grinding of the teeth, groaning, and fever, which is indicated by the dry, hot nose and staring eyes; later, the nervous symptoms mentioned above may appear. The condition should not be confused with gid.

Treatment.—Affected animals should receive the purge prescribed under "Overloading," and this should be followed with two tablespoonfuls of the following mixture in a half-pint of linseed tea twice daily: Aromatic spirits of ammonia 1½ ounces, fluid extract of nux vomica ½ dram, alcohol 2½ ounces. When the appetite returns, easily digested feed should be given, with oil-meal.

Garget.

There are two diseases commonly known under this name. One is a simple inflammation of the udder, which results from increasing the grain feed too rapidly after lambing, lying on cold ground, the bunting of the lamb, or from the milk not being removed, as may occur when a lamb dies. The udder, or a part of it, is swollen, hot and tense; the milk contains clumps of pus or streaks of blood. The other disease is a malignant inflammation in which the udder is swollen but soft or doughy, and the skin is red or purple. In addition, the general health is affected; the ewe is dull, stops eating, is feverish and loses flesh rapidly. Finally, the affected part of the gland becomes gangrenous and sloughs off. This form is infectious.

Treatment.—In the simple form of garget, five ounces of epsom salts, dissolved in a pint of water, should be given; the udder should be bathed frequently with warm water and rubbed with camphorated oil and kept milked out clean. Treatment of the malignant form is very unsatisfactory, but much good can be accomplished by preventive measures in controlling the disease. Affected animals must be isolated, and the places they have occupied cleaned and disinfected. When gangrene has set in, the affected part should be amputated. Injections of antiseptics into the udder are of no value.

Literature.

For references to literature on ailments of sheep, the reader should consult the publications cited on pages 124–146, 330, 446, 657. [Figs. 611–614 adapted from publications of the Bureau of Animal Industry, United States Department of Agriculture.]

Cheviot Sheep. Fig. 615.

By *David McCrae.*

The Cheviot is one of the mountain breeds of Scotland, named after a range of grassy hills on the eastern borderland between England and Scotland. It is noted both for wool- and for mutton-production.

Description.

The Cheviot is of medium size, hornless, face and legs white, the body closely covered with wool of a soft fiber akin to the Down wools; but unlike the Downs, which are always likely to have more or less a gray tinge to the wool, the Cheviot gives a pure white wool. The head is bold and broad, and the fleece of snowy whiteness comes close up, forming almost a ruff about the face. The ribs are flatter than in either the Southdown or the Highland. It is a very active, hardy animal, with a bright eye and erect ears. Unfortunately it has a tendency to scatter rather than flock together.

The following scale of points was adopted by the American Cheviot Sheep Breeders' Association:

Scale of Points for Cheviot Sheep	Perfect score
1. **Blood.**—Pure-bred from one or more importations from Scotland	15
2. **Constitution and Quality.**—Indicated by the form of body; deep and large in breast and	

Scale of Points for Cheviot Sheep, continued

	Perfect score
through the heart; back wide and straight and well covered with lean meat; wide and full in thigh; deep in flank; skin soft and pink in color; prominent eyes; healthful countenance. Deficiency of brisket or fish-back objectionable.	20
3. **Size.** –In fair condition, when full-matured rams should weigh not less than 200 pounds, ewes, 150 pounds (when bred in America. Imported stock, rams, 125 to 150 pounds, ewes, 100 to 125)	10
4. **General Appearance.**—Good carriage; head well up; elastic movement; showing symmetry of form and uniformity of character throughout .	10
5. **Body.**—Well proportioned; small bone; great scale and length; well-finished hind-quarters; thick back and loins; standing with legs well placed outside; breast wide and prominent in front; tail wide and well covered with wool .	10
6. **Head** —Long and broad, wide between the eyes; ears of medium length and erect; face white, but small black spots on head and ears not objectionable; straight or Roman nose; a white nose objectionable; end of nose dark (but never smut nose on top with black or brown); no tuft of wool on head	10
7. **Neck.**—Medium in length; thick and well placed on the shoulders	5
8. **Legs and feet.**—Short legs, set well apart; color white; no wool on legs; fore-legs round; hind-legs flat and straight; hoofs black and well shaped	5
9. **Covering.**—Body and belly well covered with fleece of medium length and good quality . .	10
10. **Quality of wool.**—Medium; such as is known in market as half combing wool	5
Perfection	100

History.

The cheviot has been bred for a very long period on the Scottish borders. The monks of the middle ages had the breed about the pasture lands of the old monasteries; and to the sheep-farming churchmen of Teviotdale are we indebted for the first improvements in the breed. The monks of Melrose had large flocks, which were dispersed in the border fields. It was not till about 1750 that the border farmer gave much attention to the breed or accomplished anything in its improvement.

In America.—Cheviots were taken to Canada early in the nineteenth century. In 1838, Robert Young, of Delhi, New York, made an importation, followed four years later by other importations to the same county. In 1845, they were imported into Wisconsin by T. J. Carmichael. Subsequent importations have been made, but the breed did not make much progress in America prior to 1880.

Distribution.

In the Cheviot hills, the Cheviots are still the leading breed. About the year 1800, Sir John Sinclair tried them in Caithness shire, in the extreme north of Scotland, and they have spread into Sutherlandshire, where they are bred in large numbers. They have done well in many parts of the United States, but not so well in Canada, where the close confinement of the winters is against their active habits. Wherever they can have outdoor exercise all the year round, they are at home. They are specially adapted for high, grassy tablelands. They are most numerous in central and eastern United States, but have become very widely scattered throughout the country.

Uses.

The Cheviot is remarkably hardy, and can live on very poor grazing; but, nevertheless, it must have grass of some kind, and with it needs little else. It yields a good class of well-marbled mutton, that is not too fat. It dresses a carcass of good weight. It bears traveling on foot for long distances better than other modern breeds, and is

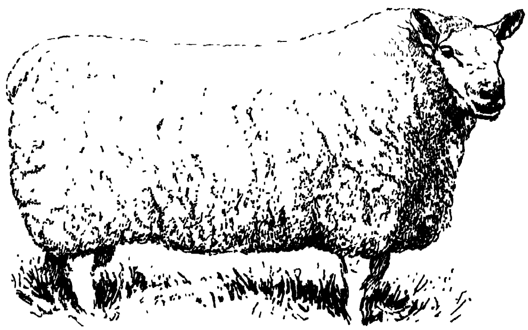

Fig 615. Cheviot ram.

exceedingly hardy. The ewes are good, careful mothers, and highly prolific. The Cheviot cannot be said to be superior as a wool-producer, owing to the light fleece, which, however, is of good quality, medium length, and in demand. According to Wallace, an average clip for ewes is four and one-half to five pounds of washed wool. The tendency of American breeding is to improved wool-production and more compact form. Cheviot ewes produce a good class of early maturing grade mutton sheep when crossed with Lincoln, Leicester or Oxford Down rams. These crosses have been popular in the native home of the breed for some years.

Organizations and records.

The Cheviot Sheep Society of Great Britain was organized in 1891, and has published a volume of its flockbook for each year, Volume I having been issued in 1893. The American Cheviot Sheep Breeders' Association was organized in 1891, at Hartwick, New York, and two years later issued its first flockbook. In 1894, the National Cheviot Sheep Society was organized at Indianapolis, Indiana. Six years later, these two societies united to form the American Cheviot Sheep Society. The latter organization continues the publication of the flockbook.

Literature.

For references, see page 596.

Cotswold Sheep. Fig. 616.

By *David McCrae.*

The Cotswold is a breed of sheep raised both for wool and for mutton. It is of large size, and capable of enduring much hardship and exposure, and well adapted to many soils. The name is derived from a range of bleak uplands in Gloucestershire, England, known as Cotswold hills.

Description.

The Cotswold is a large, high-standing breed, with heavy fleece of long, white, lustrous wool. A mature ram should weigh 250 pounds or more, and a mature ewe 200 pounds at least. An ample topknot, often covering the eyes, is one of the distinguishing characteristics of the breed. It is uniform in type, with bold, upright carriage, broad back, and shows a fair leg of mutton. It is a superior feeder, specially well adapted to good pasture land, and fairly prolific.

The following is the standard of excellence and scale of points adopted by the American Cotswold Sheep Association:

SCALE OF POINTS FOR COTSWOLD SHEEP

For rams	Perfect score
1. **Head.**—Not too fine, moderately small, and broad between the eyes and nostrils, but without a short, thick appearance; and in young animals well covered on crown with long lustrous wool.	8
2. **Face.**—Either white or slightly mixed with gray or white dappled with brown	4
3. **Nostrils.**—Wide and expanded; nose dark	1
4. **Eyes.**—Prominent, but mild looking	2
5. **Ears.**—Broad, long, moderately thin, and covered with short hair	4
6. **Collar.**—Full from breast and shoulders, tapering gradually all the way to where the neck and head join. The neck should be short, thick and strong, indicating constitutional vigor, and free from coarse and loose skin	6
7. **Shoulders.**—Broad and full, and at the same time join so gradually to the collar forward and chine backward as not to leave the least hollow in either place	8
8. **Fore-legs.**—The mutton on the arm and fore-thigh should come quite to the knee. Leg upright, with heavy bone, being clear from superfluous skin, with wool to fetlock, and may be mixed with gray	4
9. **Breast.**—Broad and well forward, keeping the legs wide apart. Girth or chest, full and deep.	10
10. **Fore-flank.**—Quite full, not showing hollow behind the shoulder	5
11. **Back and loin.**—Broad, flat and straight, from which the ribs must spring with a fine circular arch	12
12. **Belly.**—Straight on under-line	3
13. **Quarters.**—Long and full, with mutton quite down to the hock	8
14. **Hock.**—Should stand neither in nor out	2
15. **Twist,** or junction inside the thighs, deep, wide and full, which, with a broad breast, will keep the legs open and upright	5
16. **Fleece.**—The whole body should be covered with long lustrous wool	18
Perfection	100

SCALE OF POINTS FOR COTSWOLD SHEEP, continued.

For ewes	Perfect score
1. **Head.**—Moderately fine, broad between the eyes and nostrils, but without a short, thick appearance, and well covered on crown with long lustrous wool	8
2 **Face.**—Either white or slightly mixed with gray, or white dappled with brown	4
3. **Nostrils.**—Wide and expanded, nose dark	1
4. **Eyes.**—Prominent, but mild looking	2
5. **Ears.**—Broad, long, moderately thin and covered with short hair	4
6. **Collar.**—Full from breast and shoulders, tapering gradually all the way to where the neck and head join. The neck should be fine and graceful, and free from coarse and loose skin.	5
7. **Shoulders.**—Broad and full, and at the same time join so gradually to the collar forward and chine backward, as not to leave the least hollow in either place	8
8. **Fore legs.**—The mutton on the arm or fore-thigh should come quite to the knee. Leg upright with heavy bone, being clear from superfluous skin, with wool to fetlock, and may be mixed with gray	4
9. **Breast.**—Broad and well forward, keeping the legs wide apart, girth or chest full and deep	10
10. **Fore-flank.**—Quite full, not showing hollow behind the shoulder	4
11. **Back and loin.**—Broad, flat and straight, from which the ribs must spring with a fine circular arch	12
12. **Belly.**—Straight on under-line	5
13. **Quarters.**—Long and full, with mutton quite down to the hock	8
14. **Hock.**—Should stand neither in nor out	2
15. **Twist,** or junction inside the thighs, deep, wide and full, which, with a broad breast, will keep the legs open and upright	5
16. **Fleece.**—The whole body should be covered with long lustrous wool	18
Perfection	100

History.

The Cotswold is an old English breed, whose antiquity is undoubted. It is one of the earliest sheep mentioned by name in Anglo-Saxon records. In the time of the Roman conquests, the region from which these sheep came is said to have been famous for the production of wool. Low suggests that the Cotswold was developed from the sheep found in the counties of Warwick and Oxford at an early period. The modern Cotswold is not so large nor so high-standing as was the older breed, but has more style, being remarkable for symmetry, early maturity and weight, with a lofty carriage, a fine, well-covered head, and an abundant fleece of white, wavy wool. Much of this improvement is ascribed to the use of Leicester rams on Cotswold ewes, a practice very common about the beginning of the nineteenth century.

The type of the breed has been well maintained by the English breeders, and the flocks of the various breeders now show a uniformity that is very desirable. Garne of North Leach, Hugh Aylmer of Norfolk, Gillett of Chalsbury and Swanwick of Cirencester were notable breeders who had flocks of good type.

In America.—We have a record of an importation of Cotswold sheep by Christopher Dunn, of Albany, N. Y., in 1832. Doubtless there had been previous importations, for even at that date sheep of this type were rather common in New York. In 1834, Isaac Maynard took a small flock into Ohio. In 1837 they reached Kentucky, where they later became very popular. In 1840, Erastus Corning, also of Albany, brought over a select lot; and W. H. Sotham made an importation of nineteen about the same time. In 1854, George Miller, of Markham, Canada, brought over thirty head, and these were shown at the Provincial Fair. In Quebec Province, A. H. Torrance, of Montreal, and J. L. Gibb Compton had good flocks, from which they sold into Maine, Massachusetts and Vermont. Beginning about 1870, with the decreasing popularity of Merinos, the Cotswold experienced an increasing demand, and many flocks were established, especially in central United States.

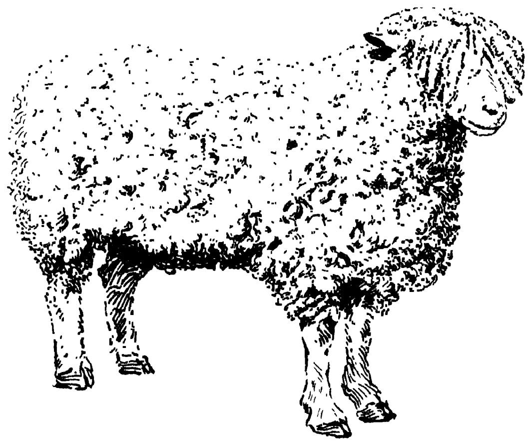

Fig. 616. Cotswold ewe.

Distribution.

The Cotswold has become wide-spread in America. The largest number of breeders are in Ontario, although there are many flocks in the other provinces of Canada. In New York, there are good flocks. Going westward, Indiana, Illinois, Ohio, Michigan, Iowa and Wisconsin stand in the order named for number of breeders, but all are exceeded by Oregon, which has the largest number of any state in the Union. There are large flocks in Utah, and many half-breeds in Montana and other sections of the West. Kentucky at one time had large flocks, and the blood there is still in evidence, but they have not been kept on record. In England, the Cotswold is most popular in its native county of Gloucester and neighboring counties. It has been exported to Russia, Germany and France, on the continent, and to Australia and New Zealand, as well as to many parts of North America.

Uses.

The Cotswold is a fair mutton sheep, giving a big carcass of strong mutton, very popular in the mining districts of England. It has not been so popular in America for mutton, except the lambs. The abundance of external fat is against it. In America it has been used for crossing on Merino and native sheep, the produce being a lamb of the mutton type, quick-feeding and hardy, weighing 120 to 140 pounds at a year old and carrying fair fleece. For wool, the breed has always been celebrated, giving a heavy fleece of strong combing wool, weighing sixteen to eighteen pounds per fleece in the best specimens. The staple should average ten inches in length, and frequently exceeds this. The half-bred lambs yield a large fleece, giving much profit to the wool-grower.

Organizations and records.

In 1878, the American Cotswold Sheep Association was formed to keep the record of the breed. Fourteen volumes of the record have been issued, with over forty thousand animals recorded. The list of breeders is steadily increasing. The present headquarters of the association are at Waukesha, Wis. The English representative of this breed is the Cotswold Sheep Society of England, organized in 1892. It also publishes a flock-book.

Literature.

For references, see page 596.

Dorset-Horn Sheep. Fig. 617, 618.

By *H. P. Miller.*

The Dorset is an English breed that takes its name from the county in which it originated. It is a mutton breed, specially valuable for crossing to produce early lambs. It is characterized by gracefully curving horns in both male and female.

Description.

In form and fleece the Dorset-Horn closely resembles the Down breeds, but in some features presents strong contrasts. Its face and legs are pure white, and the modern American type has a flesh-colored nose. Both sexes have horns, the rams very heavy ones that have a forward spiral curve. In size these sheep are between the Southdown and the Shropshire, the standard weight for rams being about 200 pounds and for ewes, 160 pounds. They generally are taller than either of the above, but are not so uniform. In length, quality and quantity of fleece they are also between the above two breeds. Some of the breed early brought to America were excessively tall and inclined to be coarse. They were also quite bare of wool on legs and belly. The prevailing type at present approaches the Shropshire in form, although it is not so heavy in the breast and chest. It is now well covered over the body and legs to knees and hocks, and has a good foretop. There is still lack of uniformity, style and quantity of fleece. A somewhat common defect is a constricted heart-girth. The breed stands confinement well and is a good feeder. It is also prolific. [A general discussion of the mutton type is given on pages 51, 52.]

The Continental Dorset Club adopted the following scale of points for scoring Dorset-Horn Sheep:

Scale of Points for Dorset-Horn Sheep

	Perfect score
1. **Head.**—Neat, face white, nostrils large, well covered with wool on top and under jaws	5
2. **Horns.**—Small and gracefully curving forward, rather close to jaw	5
3. **Eyes.**—Prominent and bright	2
4. **Ears.**—Medium size and covered with short white hair	2
5. **Neck.**—Short, symmetrical, strongly set on shoulders, gradually tapering to junction with head	5
6. **Shoulders.**—Broad and full, joining neck and chine, with no depression at either point	15
7. **Brisket.**—Wide and full, chest full and deep	8
8. **Fore-flank.**—Full, showing little depression behind shoulder	8
9. **Back and loin.**—Wide and straight; ribs should spring with a fine circular arch	10
10. **Quarters.**—Wide and full, with mutton extending down to hock	10
11. **Belly.**—Straight on under-line	3
12. **Fleece.**—Medium grade, of even quality, extending over belly and well down on legs, and presenting a smooth surface	12
13. **General conformation.**—Of the mutton type, body moderately long; short, stout legs, placed squarely under body; skin pink; appearance attractive	15
Perfection	100

History.

The Dorset is one of the oldest distinct breeds in England, no other race having been mingled with it originally, within the time of any records referring to it. It was first mentioned in 1707, when it was reported to have yeaned in December and again in June. The two counties of Dorset and

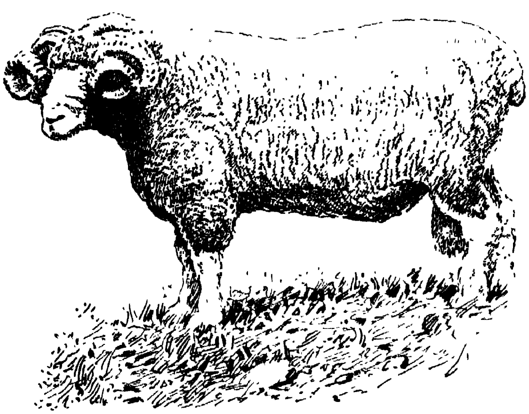

Fig. 617. Dorset-Horn ram.

Somerset seem to have been the home of two races, differing somewhat, which became mingled in the present Dorset. The original stock of Dorsetshire was small, light in the shoulders, with white face and legs and a black nose. Both males and females bore horns. The stock of Somerset was larger, coarser, longer-wooled, with flesh-colored nose and better form. The Dorset seems never to have had a devotee with the genius of Bakewell or Ellman, and at one time came near losing its identity

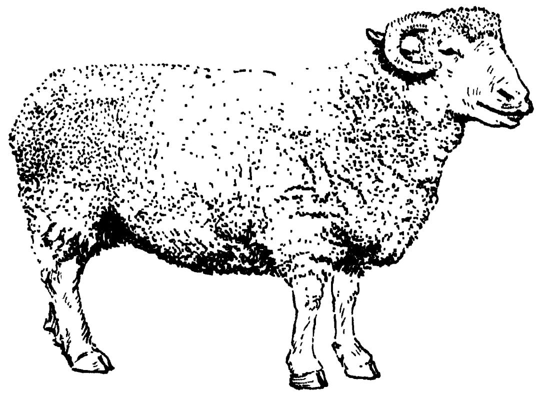

Fig. 618. Dorset-Horn ewe.

through admixture of the improved breeds of the day. Its ability to produce lambs earlier than any other breed seems to have saved it.

The Dorset was first recognized at the leading English shows in 1862. It has been greatly improved since that date; in fact, American breeders have greatly modified and unified the breed in the past quarter century.

In America. The introduction of Dorsets to America has been very recent. The first specimens were shown at the Chicago Fat Stock Show, in 1885. That same year an importation was made into Canada. In 1887, A. Thayer, of Hoosic Falls, New York, and E. F. Bowditch, of Framingham, Mass., made importations. In 1889, T. S. Cooper, of Pennsylvania, imported 153 head. They have not as yet gained the popularity in America that other English breeds have, and have had only a limited trial on the ranges.

Distribution.

The principal flocks in America are to be found in New Jersey, New York, Ohio, Indiana, Pennsylvania, Virginia and Canada, although the sheep are found in other states. A few have been taken to Australia and elsewhere, but they have not the wide dissemination of the other English breeds. They are numerous in their native counties of Dorset and Somerset, in England, while very excellent flocks may be found on islands of Wight and Portland.

Uses.

The strong recommendation of the breed in America, as in England, is for the production of hothouse or winter lambs. It will breed earlier than any other of the English breeds, and the ewes, being heavy milkers, prepare their lambs for market in about ten weeks, so that they command a good price for mutton. Under high feeding they

will produce lambs twice a year in some climates, but it has never proved expedient to have them do so. It is doubtful whether they have superior merit as a general farm sheep, but for the production of early market lambs they are especially suited. Rams of the breed are very satisfactory for use on grade Merino ewes in the production of feeders. The ewes are also bred to Shropshire or Southdown rams to produce market lambs. The mutton, except that of fat lambs, is not superior.

For wool-production the Dorset-Horn has rather a light fleece. The fleece is short, and still somewhat scant under the body. Ewes average about six pounds and rams about seven pounds of wool of fair quality. The fleece probably has the least oil of any of the middle-wool breeds, and is less dense.

Organizations and records.

The American Dorset-Horn Sheep Breeders' Association was organized in 1891, and the Continental Dorset Club in 1897. The former issued two volumes of its flockbook bound together, in 1894, and the latter issued its seventh volume in 1907. The Continental Dorset Club publishes a book on the breed entitled "The Winter Lamb." The Dorset-Horn Sheep Breeders' Society of England, organized in 1891, has issued six volumes of its record.

Literature.

For references, see page 596.

Hampshire Down Sheep. Figs. 133, 619, 620.

By *H. P. Miller.*

The Hampshire breed derives its name from the county of that name in the south of England, one of the counties in which it was developed. It is a mutton breed.

Description.

The Hampshire is a black-faced breed, larger than the Shropshire, and is ranked by some persons as the largest of the Down breeds, although that distinction is generally accorded the Oxford. An average weight should be 250 pounds for mature rams, and 185 to 195 for mature ewes.

It is the coarsest in bone and head of any of this group. Its fleece somewhat resembles that of the Southdown, although it is coarser and less dense. The breed ranks rather low in wool-production, the Suffolk only ranking lower. The wool is of about the same grade as that of the Shropshire, but shorter, and covering the body less completely. The face is inclined to be long, and the nose somewhat Roman in the rams. The ears are large and drooping, the face and legs are almost black, or a very dark brown. As compared with the Shropshire, it is somewhat longer in body and leg, and perhaps 10 per cent heavier. The ewes are prolific and heavy milkers. They strongly compete with the Shropshire in the production of twins. [A general discussion of the mutton type is given on pages 51, 52.]

The American Hampshire Down Sheep Breeders' Association adopted the following standard in 1890: Head moderately large but not coarse, and well covered with wool on forehead and cheeks; nostrils wide; color of head and legs, dark brown or black; eyes prominent and lustrous; ears moderately long and thin; legs well under outside of body, straight, with good size of bone; neck a regular taper from shoulders to head, without any hollow in front of shoulder, set high up on body; shoulders sloping, full, and not higher than the line of the back and neck; chest deep and full in the heart place, with breast prominent and full; back straight with full spring of rib; loin wide and straight without depression in front of hips; quarters long from rumps to hips without sloping, and deep in thigh; also broad in hips and rumps with full hams; inside of thighs full.

Scale of Points for Hampshire Sheep

	Perfect score
1. **Head.**—Size and shape	5
2. **Eyes and ears**	3
3. **Color**	5
4. **Legs and feet**	2
5. **Neck, shoulders and breast.**—Neck	5
Shoulders	10
Chest and breast	15
6. **Body.**—Back and loins	15
Ribs	5
7. **Hind-quarters.**—Length	10
Width	10
Twist	5
8. **Wool.**—Forehead and cheeks	2
Belly well covered	3
Quality	5
Perfection	100

History.

The Hampshire Down sheep was produced by the use of the Southdown on the Wiltshire-horned and the Berkshire-knot sheep. The former was a white-

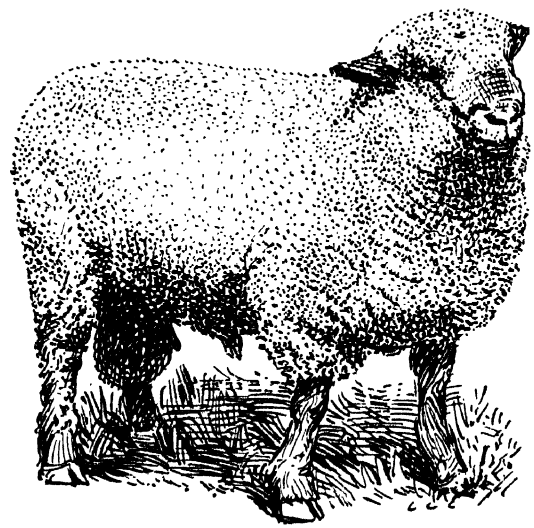

Fig. 619. Hampshire ram.

faced race, and the latter black-faced. The Wiltshire was considered the largest of the native breeds. Mr. William Humphrey, of Newbury, Hampshire, who is accredited as being the first and

greatest improver of the breed, assembled, about 1834, a flock of carefully selected ewes of what were then referred to in a general way as West-Country Downs, including the two above-mentioned local strains. He began his work of improvement by selection, but later became imbued with the idea

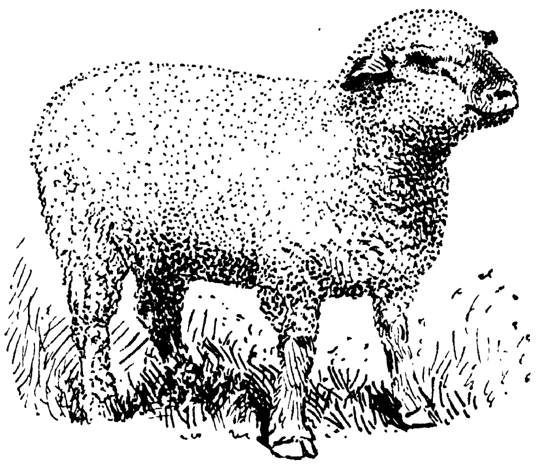

Fig. 620. **Hampshire ewe.**

that crossing would be advantageous, and in successive years purchased three Southdown rams from Jonas Webb. A little later, James Rawlence began improvement of what was known as the Sussex sheep. He used some Hampshire and West-Country Down blood. Later, the two flocks were coalesced to form the Hampshire Down breed. Hampshires were first accorded a class at the Royal Agricultural Society Show in 1857.

In America.—Hampshire Down Sheep were imported into America in 1855 by Thomas Messenger of Long Island. No further importations are recorded until 1881. In that year, Henry Metcalf, of Canandaigua, New York, imported the ram, Shepherds' Pride 2. In 1883, the breed was introduced into Michigan, and in 1885 into Ohio.

Distribution.

This breed is now widely disseminated throughout the United States and Canada, especially in the eastern sections. It seems hardy and well adapted to American conditions, and is a good grazer. It has made its way throughout the southern counties of England, and into all the English colonies. Now it is found in many countries, among which, aside from North America, including Mexico, may be named Russia, Germany, Portugal, Hungary, South Africa, Australia, New Zealand and several parts of South America, notably Argentina and Uruguay.

Uses.

The claim of the breed to superiority is based on the rapidity with which the lambs grow. In England, the flocks are generally folded, and the lambs fed for rapid development. It is not unusual for a Hampshire lamb to gain a pound a day. The breed ranks very well for mutton-production, especially where early market lambs are wanted. In this country, Hampshire rams are especially prized for siring lambs to be marketed at three to five months of age. They are winning some favor on the range, as sires for mating with Merino grade ewes. The lambs are said to be good rustlers. Pure-breds will doubtless prove profitable for the production of lambs to be marketed in the early spring or summer. But pure-bred flocks will be chiefly valuable in America for the supply of rams for cross-breeding.

As has been said, for wool-production the Hampshire Down is very mediocre. The fleece is light, short, and of rather inferior quality.

Organizations and records.

The Hampshire Down Sheep Breeders' Association was organized in England in 1889, and had published seventeen volumes of its flockbook up to 1907. The Hampshire Down Sheep Breeders' Association of America was also organized in 1889, and had issued nine volumes of its flockbook up to 1907. The number of registrations in each is large.

Literature.

For references, see page 596.

Leicester Sheep. Fig. 621.

By *David McCrae.*

The Leicester (pronounced Les'ter) sheep are a long-wool mutton breed, developed largely in the county of Leicester in England. The land in this county is fertile and rolling, and well adapted for sheep-raising.

Description.

The Leicesters are a hornless breed of sheep, of large size, rectangular form of body on clean legs, and with bare faces or carrying a very scant topknot.

The Leicester breeders have no authorized standard of excellence or scale of points. The fact that there are two types in the breed, the English or Bakewell, and the Border Leicesters, and that these vary somewhat in form and details, has so far prevented the adoption of a uniform scale. Both types are recognized by all Leicester associations. The following scale of points, prepared by the writer, favors the Border type, and, while not authorized, has been carefully considered and approved by good judges of the breed. It is introduced here merely as a suggestion.

Scale of Points for Leicester Sheep

	Perfect score
1. **Head.**—Long, moderataly small, tapering towards the muzzle ; white and well covered with hair; lips and nostrils black	6
2. **Nose.**—Somewhat narrow, almost straight in ewes and slightly Roman in rams	2
3. **Face**—Having a wedge-shaped appearance, well covered with fine white hairs	2
4. **Ears.**—Thin, rather long, mobile and directed backward; a black speck on face and ears not uncommon	2
5. **Eyes.**—Large and prominent	4

Scale of Points for Leicester Sheep, continued

	Perfect score
6. **Neck.**—Strong and moderately short, level with the back and broad at its base where it leaves the chest, gradually tapering toward the head, being fine where head and neck join; neck straight from chest, showing a straight line from rump to poll	6
7. **Breast.**—Deep, broad and full	8
8. **Shoulders.**—Upright, wide across the top, giving good thickness through the heart	6
9. **Chest.**—Well filled behind the shoulder, with large girth	6
10. **Back.**—Broad and well-fleshed; ribs well sprung; loins wide; hips level; quarters straight and long	12
11. **Barrel** round, well ribbed home; straight lines above and below	10
12. **Legs** of moderate length, fairly large and wide apart, with strong, flat bone, covered with white hair; brown hair or spots objectionable	6
13. **Flesh** firm, springy pelt; pink skin	8
14. **Fleece** fine, uniform and sound in staple, curly, with good bright luster and no dark hairs or kemp; belly well covered	10
15. **Carcass.**—Rectangular, legs well set on, hocks straight, pasterns good, with neat feet; good general appearance	12
Perfection	100

History.

The Leicester sheep are named from the county of Leicester (Les′ter) in England, where the breed had its origin. Robert Bakewell of Dishley, near Loughborough in Leicestershire, began his sheep-breeding efforts about 1755. His object was to produce a breed that would fatten quickly at an early age. Before this, bulk of body and weight of fleece had

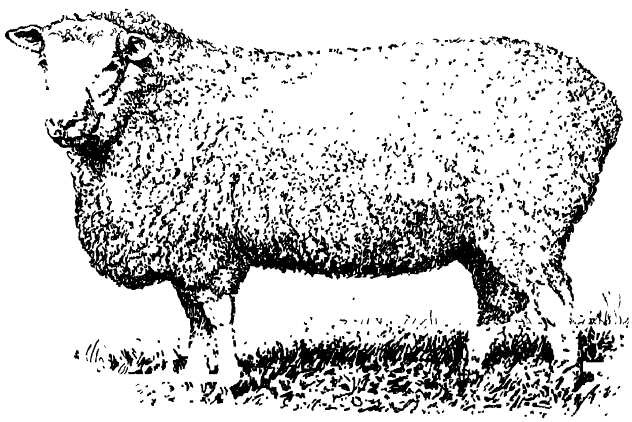

Fig. 621. Leicester ram.

been the aim of breeders of long-wools. The common sheep of the county at that time were large, heavy and coarse-wooled, white-faced, flat-sided, with large bones and long, thick, rough legs. Mr. Bakewell would never tell how he got his flock up to the excellence which later distinguished it, nor yet the breeds he used, but it is thought that the basis was the old Teeswater breed, modified by selections from the local breeds of long-wools in the district. This Teeswater breed, from the valley of the river Tees in Yorkshire, was a tall, clumsy animal, small in the bone, round in the rib, and with a thin fleece of long wool. It made good mutton, but was slow in maturing. Bakewell bred for mutton, with the least bone and the least waste, and for quick-feeding lambs. The breed was called the New Leicester or Dishley breed. Formed by careful selection and inbreeding, the new flocks had great prepotency, were sometimes delicate in constitution and shy breeders. Even now, after 150 years, these features sometimes appear.

The Dishley flock became famous. Mr. Bakewell decided to let his rams instead of selling them outright. In 1760, he let three rams for $4 each, and two for $4.50 each. The next year his price was $5 each, and this continued with varying success, until in 1780 he reached $50 for his best. Then the demand increased rapidly. In 1785, the top price was $500. In 1789, he let three rams for $6,000, seven for $10,000, and the remainder of his flock for $15,000. His reputation was established, and the New Leicester became the most popular breed in England. It was much used for crossing with other breeds to produce quick-feeding lambs; and this reputation still holds.

In America.—Bakewell or Dishley sheep reached America in colonial days. It is said that George Washington had Bakewell ewes at Mount Vernon. Others were known in Pennsylvania and New Jersey. About the beginning of the nineteenth century, Mr. Toofy, of Quebec, made an importation. Later, about 1806, they were imported into Massachusetts. In the same year, Captain Beanes brought some rams and ewes from England, and placed them on a farm in New Jersey. The Beanes flock subsequently, in the hands of others, attained much notoriety. A number of importations were made later, and gradually the breed worked westward.

In America, a type has been developed that differs somewhat from both the English Leicester and the Border Leicester, both of which types have been used in many of the flocks in Canada and the United States. Some owners assert that the modern American Leicester is a better sheep than either of the English types, and that this is the only English breed of sheep that has been improved in America. Certainly the modern American Leicester is a fine sheep, evenly developed, and when in good form is a beautiful animal.

Distribution.

The Leicesters are at home in the border counties of England and Scotland, and in other parts of Great Britain. While tried to some extent abroad, notably in part of Europe, New Zealand, Australia and America, they have not attained the reputation of the heavier-wooled breeds. In America they are found mainly in Ontario and other Canadian provinces, and in Pennsylvania, Michigan, Illinois, Iowa and Nebraska.

Types.

The Dishley or Bakewell type became widely used in England, and has become known as the English

Leicester. Because of its great prepotency and its quality of putting on fat quickly, it became popular as the greatest of all the mutton breeds for crossing purposes and for early market lambs.

The Border Leicester is so named because it is bred in the border counties of England and Scotland, Roxboroughshire in Scotland being now the headquarters of the breed. George Culley, of Denton, near Darlington in Durham, and his brother are looked on as the original breeders of the Border Leicester. The Culleys hired rams from Dishley and crossed them on a stock of Teeswater ewes till they had a flock of Leicesters. When they retired in 1806, their flock, through that of Compton of Learmouth, supplied a part of the Mertoun flock of Lord Polworth. This flock has been bred with the greatest care since 1802, and by judicious selection and without outside blood has been made the premier flock of the breed.

The Border breed has a white face, free from wool. The English Leicester may have a small tuft, and may be bluish white in color. At one time, blue faces were in fashion. The head and eye are important points in a quick-feeding animal. "Never pick a rascally head and a bad eye," no matter what the carcass may be, is the advice of a famous breeder.

Uses.

The Leicesters are used very much for crossing purposes, to get early lambs for the market. Having been bred more for mutton than for wool, the breed has so far not been so widely distributed in America as its good qualities deserve. Of late years, however, the market for fat lambs has become a feature, and there is now more demand for the Leicester for cross-breeding. For mutton alone, the breed is inferior. It is too large and too fat, unless killed young. The cross-bred mutton on Hampshires or Merinos is superior to the pure-bred. The Border Leicester-Cheviot cross has found much favor for the production of choice mutton for the British market.

The wool of the Leicester is fine and long, and the fleeces will weigh nine to eleven pounds. Fine-wool rams on grade Leicester ewes produce a fine, compact fleece that is heavier than that of the Leicester pure-bred.

For grazing, the Leicester is in no way superior. It is not specially hardy, and cannot rustle sufficiently well to adapt it to much of the range lands.

Organizations and records.

The first organization devoted to the Leicester was the Dishley Society, which was formed to sustain the efforts of Bakewell. This society has been succeeded by the Leicester Sheep Breeders' Society. In England there is also the Society of Border Leicester Sheep Breeders. The American Leicester Breeders' Association has issued four volumes of its flockbook, since its organization in 1888.

Literature.

For references, see page 596.

Lincoln Sheep. Fig. 622.

By *David McCrae.*

This breed is of large size, with a heavy fleece of long, wavy or curly wool and a moderate tuft of wool on the face.

Description.

For many years, the fleece has been made a leading feature of the Lincoln breed. The wool is long, somewhat lustrous and of a strong and sound combing quality. For length of fiber and strength of staple, no other breed but the Cotswold can rival the Lincoln. The color is white. The head is large, and without horns. The sheep gives the impression of massiveness. It is gentle, and a good feeder, maturing early. Its grazing qualities are fair. It cannot be said to be very prolific.

SCALE OF POINTS FOR LINCOLN SHEEP

Sheep	Perfect score
1. **Constitution.**—Body deep, back wide and straight, wide and full in the thigh; bright large eyes; skin soft and pink	25
2. **Size.**—Matured rams not less than 250 pounds when in good condition; ewes 200 pounds or over	10
3. **Appearance.**—Good carriage and symmetry of form	10
4. **Body.**—Well proportioned, good bone, good length; broad hind-quarters; legs standing wide apart; breast wide and deep	15
5. **Head.**—Covered with wool to the ears; tuft on forehead; eyes expressive, ears fair length, dotted or mottled in color	10
6. **Neck.**—Medium length; good muscle; well set on body	5
7. **Legs.**—Broad and set well apart, good shape; color white, but some black spots do not disqualify; wooled to the knees	10
8. **Fleece.**—Of even length and quality over the body; not less than eight inches for one year's growth	10
9. **Quality of wool.**—Rather fine, long wool, strong lustrous fiber; no tendency to cot	5
Perfection	100

History.

On the eastern coast of England lies the county of Lincoln, which contains a large tract of fen or marsh land, lying exposed to the North sea and very little above it. On this flat fen land has been bred a race of sheep which takes its name from the county, and which has made for itself a world-wide reputation. In olden times, the sheep raised on the fens of Lincolnshire were remarkable for large size and for length of wool. They had also large limbs, big hoofs, hollow flanks and flat sides. We know little about the origin of the old Lincoln breed. Ellis, who published his "Shepherd's Guide" in 1749, is the first to mention them as an established breed in the fens of Lincoln. He says that they were "the longest legged and largest carcased sheep of all others; and although their legs and bellies were for the most part void of wool, yet they carried more wool on them than

any sheep whatsoever." The modern Lincoln is said to be the product of a Leicester cross on the old Lincoln. It is a fine representative of the long-wool sheep, and yields a very heavy fleece of combing wool.

In America.—Lincolns were first brought to New England about the close of the eighteenth century. In 1825, an importation was made to Massachusetts by A. A. Lawrence. In 1834, they

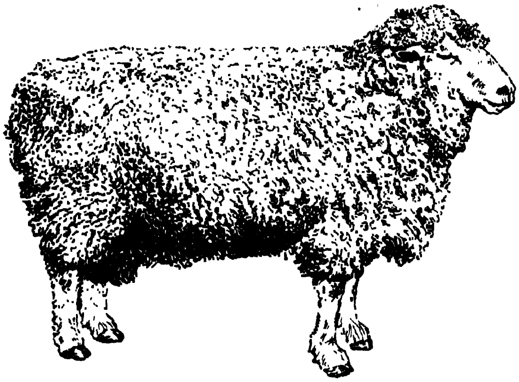

Fig. 622. Lincoln ram.

reached Ohio. An importation was made to New York in 1836 by L. D. Clift. Since that time importations have been made to both Canada and the United States. The breed has not been popular in this country.

Distribution.

Lincoln sheep are still largely bred in their old home in Lincolnshire and neighboring counties in England. In Australia and New Zealand they are favorites for crossing purposes. They have also reached Russia and South Africa. In South America they are popular, and very high prices have been paid for export rams to go to Argentina. In North America they have not gained the same favor. There are a few good flocks in Canada, mainly in Ontario, and a few have been tried on western ranches with more or less success.

Families.

Mention should be made of two notable flocks. One of the leading flocks in England is that of Henry Dudding, Riby Grove, Great Grimsby, Lincolnshire. It is a very large flock and has been bred carefully for about one hundred and fifty years. Rams from this flock have sold for $5,000 each. In 1907, forty-eight rams averaged $450. Another flock which has a notable record is that of J. E. Casswell, Laughton, Folkingham.

Uses.

The Lincoln is bred for wool, and its reputation has been made from the fleece. Lincolnshire has an area of about twenty-seven hundred square miles, and its annual wool clip exceeds nine million pounds of washed wool. For many centuries this wool has had a reputation for strong tough fiber, the fen wool especially having this marked toughness. It is said by many persons that the breed removed from its native fen land loses the tough, strong quality of fiber, no matter how good the pasture may be to which it is removed. Eighteen pounds of wool for mature rams, and fourteen to sixteen for mature ewes may be considered average yields.

The Lincoln has been widely used, especially in New Zealand, for crossing on Merino stock to give a long combing wool. It impresses its long-wool qualities on its offspring. This cross is also much employed in Argentina and Australia, to produce large wool sheep, and incidentally mutton, for the English market. The pure-bred Lincoln is not popular for mutton purposes, as it is too fat, and the mutton is of inferior quality.

Organizations and records.

The National Lincoln Sheep Breeders' Association of America, organized in 1891, looks after the interests of the breed in this country. It has published two flockbooks. In England there is the Lincoln Long-Wool Sheep Breeders' Association, organized in 1892. It issues a volume of its flockbook each year.

Literature.

For references, see page 596.

Merino Sheep. Figs. 52, 53, 623–627.

By *Joseph E. Wing.*

Of the Merinos there are several families, all of which are characterized by the production of fine fleece. The name "Merino" comes from Spain and has been variously explained.

Description.

The distinguishing characteristic of the Merino is its covering, which is of very fine wool, usually delicately crimped. This wool is generally short, ranging from an inch or less to four inches, and sometimes to a greater length. It is dense, that is, there are a great number of wool fibers to the square inch of skin. A Merino will carry 40,000 to 48,000 fibers to the square inch. Wool normally grows over the Merino to the tips of the ears and to the hoofs of the feet. In the Merino is seen the greatest development of wool in proportion to carcass of any breed. In Spain, the best rams of the early days are reported to have yielded about 6 to 8 per cent of their weight in wool, while in America, in about 1844, the yield had increased to 15 per cent. This, of course, is unwashed wool. The appearance of the Merino is not very pleasing. The form, seen when shorn, is usually angular, the shoulders often narrow, the back not usually so straight or strong as in some English breeds, the legs less straight and often of greater length, the neck more slender. The Merino ram usually has horns, giving the appearance of masculine vigor. The appearance of weakness in the Merino is hardly borne out by its behavior. It is very enduring and resistant, withstands storm and cold and starvation

Plate XXIII. Merino sheep. Michigan

better than most sheep, and its vital force is very strong. [A description of the wool type of sheep, together with a score-card for judging, will be found on pages 52 and 53. Because of the multiplicity of score-cards for Merinos, no one of which can be considered entirely representative, no other score-card for fine-wool sheep than that given on pages 52 and 53 will be introduced in this volume.]

History.

Merino sheep are native of Spain. The land is of variable topography, there being wide, dry plains, high, cool mountains and table-lands and well-watered valleys.

As to the origin of the Merino, little is known. Professor Low says that the sheep of Spain came originally from Phœnicia and Carthage, introduced by the Carthaginians and the Moors, and from Italy. At the beginning of the Christian era, historians related that the sheep of Spain had a superior fleece. When in the eighth century the Moors took possession of Spain, they introduced the manufacture of fine fabrics, and the sheep of Spain furnished the wool. It seems probable that the development of the Merino as a bearer of fine wool was begun at a date prior to the beginning of the Christian era.

Sheep in Spain have long been nomadic, spending the summers in the high lands and the winters on the low plains. The annual movement of these millions of sheep were notable events. In this connection it is interesting to note that the sheep were divided into two great groups as related to these drives. One group, known as Estantes, was stationary on the farms, and was composed of sheep of fairly large size, with wool somewhat coarser than that of the other type, less exposed, perhaps, to the rigors of climate. The second great group, known as Transhumantes, was made up of the migratory sheep that constituted the drives. These were subdivided into flocks or "squads" of manageable size for the movements.

In America.—Successful importation of Merinos to America began in 1801, when Seth Adams brought a pair to Massachusetts. In the same year, M. Dupont de Nemours is said to have imported one Merino ram, which had considerable influence on certain flocks in New York and other eastern states. In 1807, Seth Adams removed to Ohio, taking with him his Merinos, now considerably increased. In 1802, Colonel David Humphrey imported from Spain to Connecticut ninety-three Merinos, chiefly ewes. The good quality of these early importations attracted considerable attention among sheep-men, which resulted in increased importations. One of the most influential of these early importers was Robert Livingston, who made his first importation in 1802. By his writings and by his political influence he advanced the interest in Merinos very greatly. Another prominent importer was William Jarvis, of Vermont, then the United States consul at Lisbon. Mr. Jarvis sent to this country a total of about four thousand head, which were widely distributed through the East. All of these sheep were of superior breeding, and included representatives from the families of Paular, Escurial, Aguirre, Negrette, and Montarcos. From this time for many years Merinos were on the crest of popularity, and prices ruled very high. Plumb states that "it is estimated that from April 1, 1810, to August 31, 1811, there were brought to the United States 19,651 Merino sheep." Most of the sheep imported from Spain were of the great migratory group.

Merinos in America are now grouped in three great families, designated as the American Merino, the Delaine and the Rambouillet.

Distribution.

The Merino has become very wide-spread, and is now found in all civilized countries where flocks are kept, although it cannot be said to be universally popular or successful. It originated in a warm climate. It has shown ability to withstand hot weather and tropical climates, so long as they are dry. By far the greater part of the sheep of Australia are Merinos. It has also been important in New Zealand and Argentina. The Merino thrives in Vermont, New York, Ohio, and other north-central states, in Texas and all the states of the West, where it constitutes by far the majority of the range flocks. It has never been popular in Canada, and is not raised in England.

Families.

The principal families represented in the American importations, and hence the progenitors of our modern American Merinos, were as follows:

Paular Merinos.—The Paulars were owned by the Carthusian friars of Paular. These friars had one of the handsomest flocks in Spain, with soft, silky, close and compact wool, carrying less surface yolk than some other types. The Paular lambs were hairy at birth. The Paular subtype of the American Merino is a well-established strain.

Aguirre Merinos.—These were very well-covered sheep, with much wool about the face, and a dense, much crimped fleece. The sheep had round, broad bodies, short legs, and much loose skin in folds and wrinkles.

Atwood Merinos.—The famed Atwood family of Merinos, so popular the latter half of the past century, was formed by mating Infantados with Paulars, which much improved the type of sheep and the fleece. They were characterized by many folds.

The Escurial Merinos were nearly as tall as the Paulars but were slighter in build. Their wool was crimped and not so thick as the Paular wool.

Guadalupe Merinos.—These were heavier in bone than the Negrettes and were celebrated for both the quality and the quantity of their wool. Their fleeces were thick and crimped, and more oily than the Negrettes.

Negrette Merinos.—The Negrette Merinos were the largest and strongest of the traveling sheep of Spain. The fleeces were shorter than those of the Paulars. They were wooled on the face and to the hoofs. They were all loose skinned, with heavy dewlaps, and the rams carried large horns.

Infantado Merinos were bred by the Duke of Infantado and were very superior sheep. Their horns came close to the sides of their heads, while those of the Paulars and Negrettes stood out. Many Infantados were brought to America, notably by Colonel Humphrey.

In this connection, mention should be made of some of the families of Merinos that have been built up in European countries on foundation stock imported from Spain. Notable among these families are the Saxon, Silesian or German, Australian, French (Rambouillet) and Swedish.

Saxon Merino.—From the Escurial flocks of Spain, about three hundred Merinos were sent, in 1765, to Saxony. These were naturally among the finest wooled of Merinos, and in their new home

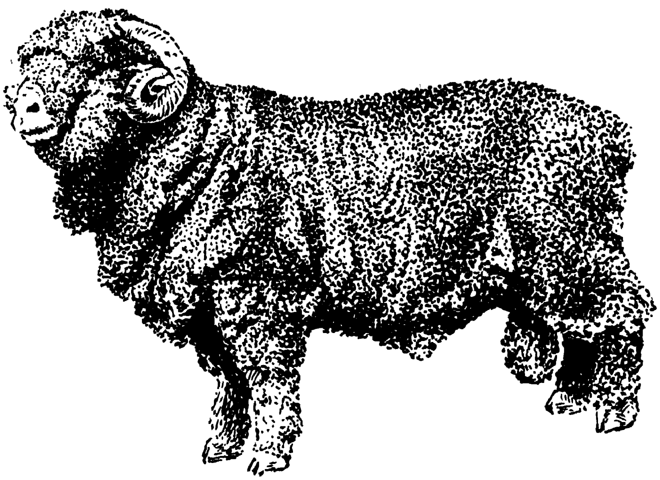

Fig. 623. American Merino ram.

more attention was paid to this quality; so much attention, in fact, that the sheep themselves lost stamina and hardiness and became very delicate and hard to raise. The wool of these sheep, however, is of extraordinary fineness and beauty. They yield about two to three pounds of washed wool per head. There are not many breeders of pure Saxon sheep in America, although they have been bred to some extent in western Pennsylvania and Virginia. This family is now almost extinct.

Silesian, or German Merino.—This breed was established in Silesia by an importation of Infantado and Negrette Merinos in 1811, although importations had been made earlier with some success, notably those of Von Vinke in 1768 and 1778. Since that day they have been bred pure, principally on the estate of Ferdinand Fishcher of Wirchenblatt. For many years a careful record of each sheep has been kept on this estate. Silesian ewes shear eight to eleven pounds of unwashed wool, the rams twelve to sixteen pounds. The wool is two to three inches long, dark on the outside, not gummy, but with a white, clear oil. The ewes weigh 110 to 130 pounds and the rams 145 to 155 pounds. There have been many Silesians imported into America. Mr. Wm. Chamberlin, of New York, imported 246 head between 1851 and 1856. It is probable that at this day most Silesians in America have become merged with one or the other of the larger Merino families.

Australian Merino.—As has been said, the Merino is the leading sheep in Australia, which places Australia at the head of the list of Merino sheep-producing countries. Taken to New South Wales in 1797, the sheep found the hot, dry ranges well suited to their needs, and to the production of a high grade of wool.

The wool.

Merino wool is most esteemed when it is fine. The diameter of a fiber of Merino wool varies from $\frac{1}{1000}$ to $\frac{1}{1800}$ of an inch, while the fibers of the English breeds vary from $\frac{1}{575}$ of an inch for an Oxford Down, to $\frac{1}{875}$ of an inch for a Southdown. It should also have a short crimp throughout its entire length, and should be strong, silky and well supplied with white oil. This oil protects the wool fibers, but at the outer ends it collects dust and gives the coat a dark and uninviting appearance, which is dispelled when the wool is opened and the beautiful white and glistening interior is viewed.

The density of the wool is an essential factor, since on that depends the weight of the scoured fleece. Sufficient oil to protect the fleece is essential, but a surplus of grease is unnecessary, and in recent years has been recognized as undesirable. During the so-called Merino craze that existed in America soon after the Civil war, the aim was to get as heavy a fleece as possible, and many breeders unwisely sought to attain this result by breeding sheep with very greasy wool. It was learned, however, that this only enfeebled the sheep without bringing any sufficient compensation, and in recent years breeders have sought to produce animals bearing only sufficient oil to well protect the fleece.

The amount of oil carried by Merino fleeces varies with the different families, the American or Spanish types having most and the Rambouillet perhaps the least oil. Merino fleeces have been grown so heavy with oil that they scoured out no more than 12 per cent of clean wool; others have made 40 per cent. Perhaps an average yield of clean wool would be about 30 per cent of the weight of the fleece as shorn. A good ewe should shear fifteen pounds and a ram twenty to twenty-four pounds of wool. Individual records may far exceed this.

Uses.

Merino sheep are kept primarily for their wool. It is true that, after they have served their time for this purpose, they are commonly fattened and made into mutton, yet the fleece is usually the first consideration with the Merino flockmaster. Much attention is paid to the quantity and quality of wool borne by these sheep. In some families of Merinos, the body surface is increased by folds

or wrinkles on the skin, which increase the wool-bearing surface. These folds are especially pronounced about the neck, and sometimes make huge "collars."

AMERICAN MERINO SHEEP. Figs. 623, 624.

The American Merino was developed from the Spanish Merino, the blood of several different families having been interbred. In recent years, the Delaine and Rambouillet types of Merinos have become more popular in America than the American Merino, owing to their better form and ability to fatten, and the high prices prevailing for mutton.

Description.

The head of a typical American Merino is small, broad and short, the rams carrying heavy, spirally-twisted horns, and the ewes being hornless. The form of the American Merino is somewhat delicate. The skin is of the most attractive pink. The prevailing fashion is to have three to five heavy folds on the neck, large on the under side, but not on the upper side; two or three short folds on and immediately back of each elbow or arm; fine, thick wrinkles running down the sides, but not extending over the back. Wrinkles may also be found across the hips, sometimes from the tail in the direction of the stifle and sometimes at right angles with them. Folds may occur around the tail to give it a wide appearance, and also across the thigh, with a deep flank. The fleece covers the entire sheep, except the tip of the nose and the hoofs. Usually the eyes are hidden by wool. The outside of the fleece is a dirty brown, but inside it is white and glistening. The one-year-old fleece will show a length of about two and one-half inches. The size of the American Merino varies much. Ewes may weigh 80 or 100 pounds, rams 100 or 175 pounds.

The American Merino does not reach maturity until between three and four years of age, and in this respect ranks below other breeds. It is characterized, however, by longevity.

Distribution.

In America, the American Merino is widely scattered, and does well under very diverse conditions. It is hardy and active, and can glean a living under unfavorable conditions. It has been largely exported to Australia and Africa. In Australia, Merinos are bred pure. In New Zealand, they are largely intermixed with sheep of mutton type.

Uses.

For wool.—American Merinos surpass all others in the production of fine, strong and heavy fleece. Mature ewes frequently shear twelve to fifteen pounds, and rams should attain to twenty pounds. Plumb, quoting from a Vermont report, says that in 1812, the best rams in Vermont produced but 6 per cent of wool to weight of body. In 1844, the wool had increased to 15 per cent, in 1865 to 21 per cent and in 1880 to 36 per cent, showing a very notable increase in the production of wool. Unfortunately we do not know what the increase in per cent of scoured wool has been.

For mutton.—The American Merino does not usually fatten so readily as other types of the Merino: and when compared with the mutton breeds it is inferior.

For crossing.—In the West, the American Merino was largely instrumental in transforming the coarse and thin-wooled Mexican ewe into one of far better and heavier fleece, with also better form and increased hardiness. The American Merino has been much used for crossing in this country and others, and the result is invariably an improvement

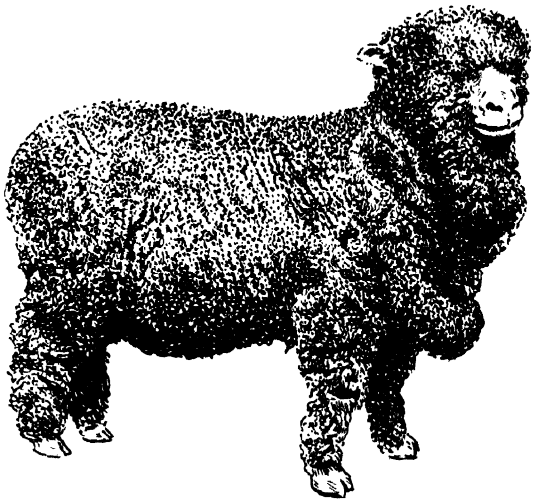

FIG. 624. American Merino ewe.

in wool-production in the grade over its other parent. Merino ewes are crossed with various of the middle-wool breeds to produce a good market mutton sheep, yielding a somewhat smaller clip of wool.

Organizations and records.

The Merino has suffered from an over-abundance of distinct organizations devoted to its interests, and the absence of one centralized and directing body. It was not until 1906 that any success was attained toward the formation of such a national society. In that year, the American and Delaine Merino Record Association was formed, by the union of the International Delaine, Standard Delaine, and Improved Spanish Delaine Merino Sheep Breeders' Associations. Among nearly a score of associations giving attention to Merino sheep may be mentioned the following, which are concerned especially with the American Merino: The Vermont Merino Sheep Breeders' Association, United States Merino Sheep Breeders' Association, American Merino Sheep Register Association, Ohio Spanish Merino Sheep Breeders' Association, New York State American Merino Sheep Breeders' Association, Michigan Merino Sheep Breeders' Association, Missouri Merino Sheep Breeders' Association, National Merino Sheep Register Association, Standard American Merino Sheep Breeders' Association. Many of these associations issue flockbooks, and employ a score-card for judging purposes.

DELAINE MERINO SHEEP. Figs. 52, 625.

The word Delaine means "of wool," and is from the French. Delaine wool can be combed and spun with the fibers of full length, making a fabric of great strength and durability. The Delaine type, of several families, has been developed from importations of Spanish Merinos, by selections from several different flocks as noted in the following paragraphs.

Description.

Delaine sheep have smoother bodies than the American Merinos, with fewer folds and wrinkles, sometimes with none. They vary considerably in type, according to the individual ideals of their

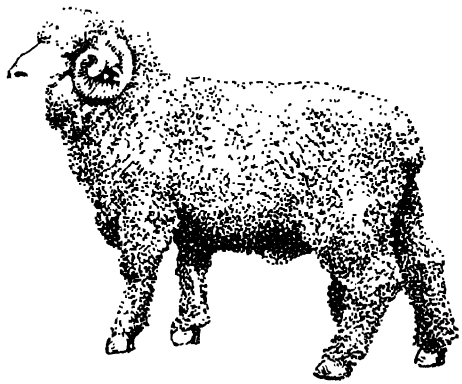

Fig. 625. Delaine Merino ram.

many breeders. They are larger and heavier than American Merinos and fatten more readily. The weight of matured rams may be given as 140 to 200 pounds, and of ewes as 100 to 150 pounds. Their breeders have striven to combine mutton qualities, to some extent, with the production of a fine fleece. The breeders avail themselves rather freely of whatever Merino blood they fancy will improve their type. Thus, when the flock is losing in weight of fleece, they sometimes resort to the use of American Merino rams to thicken the fleece and make it heavier, or to Rambouillet rams to increase the size. The important item sought is to keep good size and mutton quality, while furnishing fleece of good length and staple, grading XX or better.

Distribution.

Among breeds of Merinos, the Delaine is growing in popularity. It is found in New York, Pennsylvania, Ohio, Michigan, Iowa, and in adjoining states. For use on the ranges, the Delaines are finding increasing favor, especially where the pasturage is good. The Black-top Spanish Merino is especially numerous in parts of Pennsylvania where it was developed. They are less hardy than the American Merino.

Families.

The Dickinson Delaines were developed from sheep of the Humphrey importation of 1802, mentioned above, by William R. Dickinson of Ohio, who began his improvement of Merino sheep in 1809. James McDowell became possessed of some of the Dickinson flock and created the McDowell strain of Dickinsons. The standard of excellence for Dickinson Delaines says that the sheep shall have a deep, round, wide and long body, showing mutton capacity, carrying heavy, thick flesh, the top- and under-lines straight, the skin smooth and pink and well filled out, being free from folds. The head may have small horns, but a polled head is preferred. The fleece should be three to five inches long, of a quality to grade XX or XXX fine Delaine combing. Rams should shear fifteen to twenty-five pounds and ewes ten to fifteen pounds of unwashed wool. Mature rams should weigh 200 pounds, and mature ewes 150 pounds.

The National Delaines are descended from an importation of Merinos, made by R. W. Meade, in 1820. Mr. Alex. Reed, of Washington county, Pa., came into possession of a number of this importation the year following, and his flock may be considered the foundation of the Delaine type. Many of the Reed flock were sold to other breeders in Pennsylvania and West Virginia, who developed the type, perhaps more than Mr. Reed had done. This type is not very different from the Dickinson. It has the smooth body, characteristic of the Delaine, almost free from folds. It does not seem to be desirable to dispense with the folds altogether, as they appear to be associated with density and weight of wool. This family does not attain so large size as the Dickinson, running perhaps fifty pounds less for both male and female. The staple should reach three inches in a year, and the fleece should weigh up to nine pounds and be comparatively free from oil.

The Victor-Beall strain of this family is the result of a cross of Spanish and Black-top Merino blood. About 1877, a Spanish ram, named Victor, was used in the flock of Black-top Merinos owned by R. H. Russell. Fifteen years before, a ram of Spanish and Black-top blood, purchased from the flock of C. H. Beall, of West Virginia, had been used on some of the Reed flock, then in the hands of McClelland Bros. The offspring of the descendants of these two rams were very superior, and the strain came to be known as Victor-Beall Delaine Merino.

The Black-top Spanish Merino.—In 1821, William Berry, of Washington county, Pa., purchased some ewes and a ram of Mr. Dickinson, which he bred very carefully. He was impressed that the sheep having the darkest appearance or "top" were the hardiest and best feeders. By selecting along these lines, he developed a family that he called Black-top. It differs in no material way from the other families, the size being perhaps a little greater and the fleece a little heavier. The wool is not so much laid on over the head and has a darker appearance on the outside. The staple should reach a length of three to four inches, and the rams should yield thirteen to fourteen pounds, the ewes seven to twelve pounds of brook-washed wool. Black-top rams are horned, while the ewes have

smooth heads. The form in general is of the mutton type.

The Improved Black-top Merino also had its origin in Washington county, Pennsylvania, in the hands of George Black. Beginning about 1853, and continuing for many years, Robert Johnston, also of Washington county, used only Black-top rams on his ewes, many of his rams coming from the Berry flock. His ewes traced to the Dickinson flock. In 1850, Mr. Black came into possession of twenty-five Black-top ewes, that traced to the Dickinson flock. On these he used rams of Berry and Johnston breeding, and from this foundation developed the Improved Black-top Delaine, the word "improved" being used because the advocates considered this family superior to the Black-top Spanish.

For wool.—The Delaine Merinos bear wool a little longer and coarser in fiber than the American Merinos, with a little less crimp and less oil, and with stronger fibers well adapted to carding. The fleece in a well-kept matured ram should average twelve to eighteen pounds and in the matured ewe about nine to fifteen pounds.

For mutton.—Much may be said in praise of the quality of Delaine mutton. It easily leads in the Merino families. The wethers mature rather quickly, and sell at a good price.

For crossing.—The Delaine Merino has been used to good advantage in crossing to produce better shearing qualities without detriment to the mutton qualities. This result has frequently been secured on the western ranges.

Organizations and records.

At present, the most representative organization caring for the interests of these sheep is the American Delaine Merino Record Association, mentioned under the American Merino. Starting with the organization of the Victor–Beall Delaine Merino Sheep Breeders' Association, established in 1882, in Pennsylvania, a large number of societies have been formed, of restricted membership and more or less restricted influence. Several of these have published flockbooks, and have established score-cards for judging purposes.

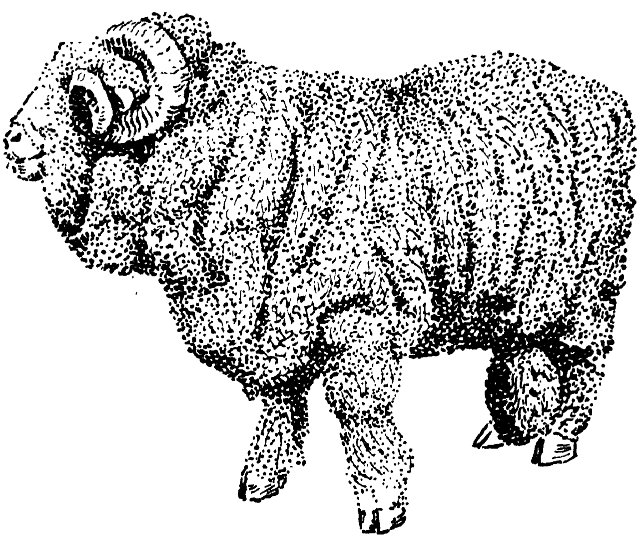

Fig. 626. Rambouillet ram.

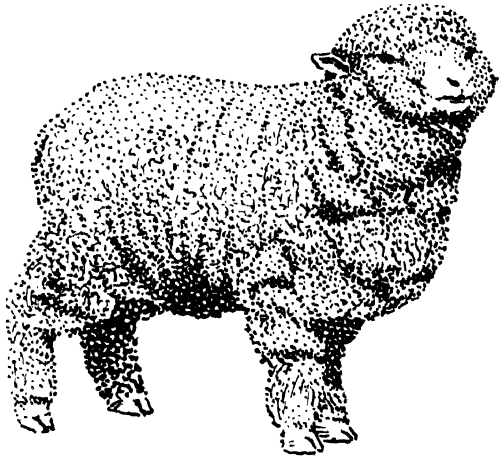

Fig. 627. Rambouillet ewe.

Rambouillet or French Merino Sheep. Figs. 626, 627.

The Rambouillet is a very large type of Merino, developed in France from Spanish Merino stock, and taking its name from the Royal farm at the village of Rambouillet, near Paris.

Description.

The most striking difference between the Rambouillet and the American Merino is in size. Rams at maturity will average in weight 175 to 185 pounds, and ewes should average 140 to 160 pounds. Individuals, both male and female, may go as much as a hundred pounds heavier. This large body, usually smooth and free from wrinkles, except perhaps, one or two folds on the neck, is completely covered with a fine white fleece, not bearing too much oil. The fleece should be dense, and the staple about three inches in length. The head is larger in proportion than in the American Merino, the nose strongly aquiline and covered with fine, white hair or short, fine wool. The rams usually have large, spirally curved horns, although horns may be entirely lacking. The ewes are hornless. Sometimes the observer is impressed by the length of leg. The Rambouillet is also characterized by hardiness, early maturity, longevity and prolificacy.

History.

The first importation of sheep from Spain to the Royal farm at the village of Rambouillet was in 1786. Other importations were made at later dates. The improvement was secured principally by selection, the object being to produce a large carcass, of good mutton form, covered

with a good fleece. Much success was attained in point of size, although the fleece did not increase in the same ratio. The French government officials kept careful records of their breeding operations at Rambouillet for upwards of a hundred years. Besides the flock at Rambouillet, other flocks were established in France, and from these important breeding farms in Germany were stocked.

In America.—Rambouillets were first brought to America in 1840, under the name of French Merinos. Many were imported during the fifteen years following, and the breed had rather wide-spread popularity. Between the years 1856 and 1860, a number of Rambouillets, bred by Mr. John D. Patterson, of New York, and descended from an importation of his own, were taken to California and became the progenitors of several very noted flocks now existing in that state. In 1851, a company of Ohio breeders, headed by A. P. Howard, made an importation.

At first, Rambouillets were welcomed, but later they went into disfavor, owing principally to an alleged lack of hardiness. The truth is, perhaps, that the Rambouillets, being larger than American Merinos, require more food, which was not always given them. About 1890, a revival of interest in the breed occurred, and since then it has greatly increased in distribution and in esteem. The later breeders have not found Rambouillet, to lack in hardiness. Much blood from the German flock of Baron F. Von Homeyer has been mingled with the bloods of France, and numerous importations from each country have been made. The *Franco-Merinos* represent the blood of the Rambouillet and the American Merino.

Distribution.

The demand for these sheep has been wide, especially for the purpose of improving wool-production by crossing on other breeds. Aside from those brought to North America, importations have been made into many parts of Europe, notably Germany, and to Australia, New Zealand, and Argentina in South America. In America, the Rambouillet is widely distributed, especially in the middle states and in Utah, Washington and down through California.

Uses

For wool.—As a wool-producer, the Rambouillet ranks below the other Merinos in percentage of fleece to body weight, and in fineness and the amount of oil and crimp, although it ranks well when compared with other breeds of sheep. The average yield of fleece is about fifteen pounds for rams and ten pounds for ewes.

For mutton.—The Rambouillet fattens well, although not equaling the English breeds in this respect, and produces a fair quality of mutton. Rambouillets on the ranges have great popularity, owing to their large size, hardiness and the ability of the ewes to hold their wool well with advanced age. Rambouillet ewes are prolific and good mothers, and their lambs are usually hardy and strong at birth, and come on fast.

For cross-breeding, the Rambouillet is in great favor. Crossed with sheep of any of the mutton breeds it nicks well, making a very fine lamb, large, quick to fatten, and having a good, heavy fleece of excellent wool. It is also used very successfully on American Merinos to produce a smoother lamb of greater size and hardiness.

Organizations and records.

In 1889, the American Rambouillet Sheep Breeders' Association was organized at Pontiac, Michigan. It issues a flockbook. In 1901, the advocates of the sheep imported from the Von Homeyer flock organized the Von Homeyer Association of Rambouillet Sheep. The Franco-American Merino Association was organized in 1900. Neither of the latter two associations at any time has been very strong or has had much influence on the development of the breed.

Literature.

For references, see page 596.

Oxford Down Sheep. Figs. 628, 629.

By *H. P. Miller.*

The name Oxford as applied to sheep is derived from the county of Oxford, England, where the breed was developed. The Oxford Down is a typical mutton breed of sheep.

Description.

The Oxford is the largest of the Down breeds. It stands very much higher than the Shropshire and is more rangy. It is more nearly straight on the under-line. It has longer and coarser fleece than any other of the group. Being a cross-bred sheep of rather recent origin, the type is not so

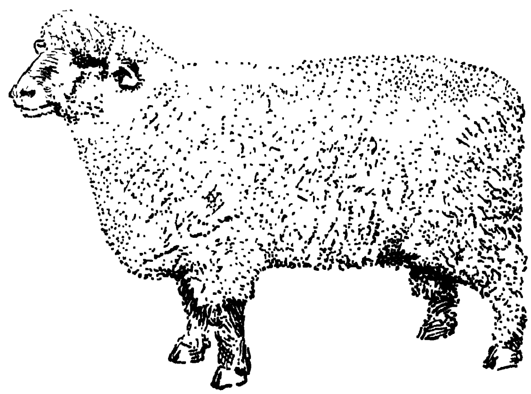

Fig. 628. Oxford Down ram.

well established as with the other Down breeds. Some specimens are coarse and rather open in fleece, and others finer and more compact. From the Hampshire line of ancestry, it inherits a tendency to dark or bluish skin, and black spots and hairs in the fleece, which are very objectionable. However, it is being rapidly improved in these

particulars. The Oxford Down has a very stately appearance and is a very attractive sheep. The color of face and legs is a darker brown than that of the Shropshire, but it is often flecked with gray, which may even predominate on the nose.

The ewes are very prolific, probably more so than any other breed, even triplets being not uncommon. They are heavy milkers. The lambs grow very rapidly and are of good form, and the ewes yield large fleeces. The one shortcoming of the breed is that it does not seem hardy under American climatic conditions. It succumbs easily to invasions of internal parasites and to pulmonary disorders. [A general discussion of the mutton type is given on pages 51, 52.]

The American Oxford Down Record Association adopted the following scale of points:

SCALE OF POINTS FOR OXFORD DOWN SHEEP

	Perfect score
1. **Form.**—Of a good general appearance, made by a well-balanced conformation, free from coarseness in any part and showing good style at rest and in motion	15
2. **Head.**—Of moderate length and width between the ears and between the eyes, and well covered with wool over the poll and down to the eyes. Color of face an even dark gray or brown, with or without gray spot on nose	6
3. **Weight.**—When fully matured and in good condition, rams should weigh 250 to 350 pounds, ewes 180 to 275	5
4. **Ears.**—Medium size, not too thick and of an even brown or dark gray color	2
5. **Legs.**—Short, strong in bone, flat and even brown or dark gray color, placed squarely under body and well apart	2
6. **Girth.**—Large around the heart and wide and full in chest	10
7. **The movement** must be bold and vigorous	5
8. **Eyes.**—Bold, prominent and bright	4
9. **Skin.**—Bright pink in color	3
10. **Neck.**—Strong and muscular in rams and well set on in both sexes	3
11. **Back.**—Wide and straight on top of shoulders and back, loin and rump, from base of neck to tail	15
12. **Full shoulders and thighs,** well meated inside and out	5
13. **Flanks.**—Well filled and strong, so as to make the lower line of the body as straight as possible, and side lines straight or rather full	4
14. **The whole carcass** evenly covered with good, well-marbled meat	6
15. **Fleece.**—Of moderate length, close and of even quality, covering the whole carcass well, and free from black patches on the body, neck or head	15
Perfection	100

History.

About 1829, John T. Twynham conceived the idea of developing a new breed of sheep combining the good qualities of the long-wools and the Down breeds, by mating the most compact Cotswold rams obtainable with his Hampshire ewes. A few years later, Samuel Druce and Wm. Gillett began a similar system of crossing, although introducing Southdown blood to some extent. The Hampshire, however, was the chief source of Down blood used in the new breed. The cross soon became popular, and several other persons undertook the same line of breeding or used the cross-bred rams so that there was no necessity for in-and-inbreeding; and it does not appear to have been employed to the extent that it was in the case of the Southdown. There is no definite record as to how long the

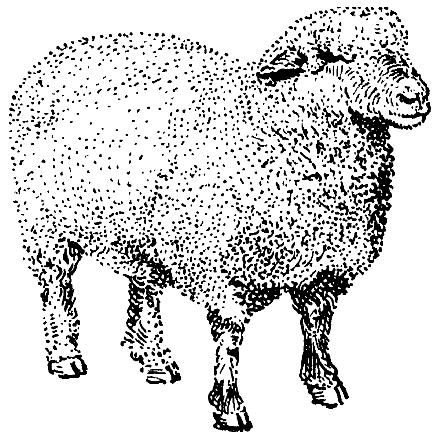

Fig. 629. Oxford Down ewe.

cross-breeding was continued, but, in 1853, Mr. Druce wrote that he had no difficulty in keeping the form and size of the animal as it should be, and the wool of a desirable quality and not deficient in quantity. Up to 1857, however, it was known as Down-Cotswold, but in that year the name "Oxfordshire Down" was adopted. A little later it was changed to Oxford Down, and these sheep are now generally referred to as Oxfords. They were first exhibited at the Royal Agricultural Society Show in 1851, but a separate class was not granted them until 1862. That may be taken as the date when they became a recognized breed with a fixed type.

In America.—This breed had gained enough recognition by 1846, so that it was in that year imported to America by Clayton Reybold, of Delaware. In 1853, small flocks were brought to Virginia and Massachusetts. The following year, J. T. Andrew, of West Cornwall, Conn., imported a flock that spread the fame of the breed. In 1857, Andrew sold a small flock to Messrs. Smith, of Middlefield, Mass., and to C. L. Whiting, of Granville, Ohio. In 1859, Andrew sold a flock to C. G. Forshay, of Texas. Interest in the breed then subsided, and did not revive until about 1880. W. A. Shafor, of Ohio, R. J. Stone, of Illinois, Geo. McKerrow, of Wisconsin, and Robert Miller, of Ontario, in the next few years imported large numbers and disseminated them widely through the United States and Canada.

Distribution.

This breed is found most largely in the states east of the Mississippi river and north of the Ohio

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river, and in Canada, appearing not to be suited to range conditions. It has spread from its original territory in England to almost every country where other English breeds have gone, which includes most of the leading live-stock countries. It is adapted to small farms where intensive methods are practiced.

Uses.

Oxfords are especially useful to produce mutton lambs to be marketed in the early summer, at four to five months of age. Under high feeding the ewes of many families will produce 150 per cent of lambs that grow rapidly. The rams are well adapted for mating with smaller breeds for the production of lambs to be fattened at eight to ten months of age. There is a considerable demand for pure-bred rams for this purpose. Oxford ewes will yield about 10 per cent more wool than Shropshire ewes, that is rather coarse in quality and of long staple.

Organizations and records.

In 1881, the American Oxford Down Record Association was organized, with headquarters at Hamilton, Ohio. Ten volumes of the record had been issued up to 1907, and 35,500 animals recorded. In England, the interests of the breed are in the hands of the Oxford Down Sheep Breeders' Association. It has issued a flockbook each year since its inception in 1888.

Literature.

For references, see page 596.

Shropshire Down Sheep. Figs. 51, 630, 631.

By *H. P. Miller.*

The name Shropshire, as applied to sheep, was derived from the county of that name in England where the breed was developed. The breed is officially known as Shropshire Down, but the name is often abbreviated to Shrop. It is a mutton breed, or perhaps we may properly consider it a general-purpose breed.

Description.

The Shropshire now has uniformly dark brown face and legs, is 10 to 15 per cent heavier than the Southdown, the standard weight for rams being 225 pounds and for ewes 175 pounds. Many, however, exceed these weights by fifty pounds when in show condition. It has a broad head, short face, thick, muscular neck, closely knit shoulders, symmetrical body somewhat barrel-shaped, except that it is straight on the back. In form it is not so good in the thigh and twist as the Southdown. In general outline, it is taller and more rangy, but the present tendency is toward the Southdown in form. The Shropshire is possessed of great fecundity, early maturity and quick-fattening qualities. [Mutton and fine-wool sheep types are discussed on pages 51–53.]

The American Shropshire Sheep Association adopted the following scale of points :

Scale of Points for Shropshire Sheep	Perfect score
1. **Constitution and quality,** indicated by the form of body; deep and large in breast and through the heart; back wide, straight and well covered with lean meat or muscle; wide and full in the thigh, deep in flank; skin thick but soft and of a pink color; prominent, brilliant eyes and healthy countenance	25
Objections: Deficiency of brisket, light around the heart, fish back, pointed shoulders, tucked-in flank, pale or too dark skin.	
2. **Size.**— In fair condition, when fully matured, rams should weigh not less than 225 pounds and ewes not less than 175	10
Objections: Rams in full flesh, 175 pounds or under; ewes in full flesh, 150 pounds or under.	
3. **General appearance and character** —Good carriage, head well up, elastic movement, showing great symmetry of form and uniformity of character throughout	10
Objections: Head drooping, low in neck, sluggish movement.	
4. **Body.**—Well proportioned; medium bones; great scale in length; well finished hind-quarters; thick back and loins; twist deep and full, standing with legs well placed outside; breast wide, extending well forward	15
Objections: Too fine bones, short body, deficient in twist, legs close together, light in brisket.	
5. **Head.**—Short and broad; wide between the ears and between the eyes; short from top of head to tip of nose; ears short, of medium size; eyes expressive; head should be well covered with wool to a point even with the eyes, without any appearance of horns; color of face dark brown	10
Objections: Horns disqualify; white face disqualifies; head with prominent bones; bare on top of head.	
6. **Neck.**—Medium length, good bone and muscular development; and especially with the rams, heavier toward the shoulders, set high up and rising from that point to back of head	5
7. **Legs and feet.**—Broad, short, straight; well set apart; well shaped; color dark brown, and well wooled to the knee	10
8. **Fleece.**—Body, head and legs to the knees well covered with fleece of even length and quality; scrotum of rams well covered with wool . . .	10
9. **Quality of wool.**—Medium, such as is known in our markets as "medium delaine" and "half combing," strong, fine, lustrous fiber, without tendency to mat or felt; and at one-year's growth not less than 3½ inches in length . . .	5
Perfection	100

Additional points: The nose of the ram should be broad and wrinkled; the ears of both sexes of an even dark color, and neither erect nor drooping; a soft black color of face and legs is preferred; black and gray wool anywhere and coarse wool on the hips are objectionable.

History.

Its friends claim for the Shropshire an equally remote origin with the Southdown. The name, as applied to sheep, is mentioned in English literature as far back as 1341, there being at that time a grade of wool designated as Shropshire. The breed had not taken on many of its present characteristics, however, a century ago, as Plymley, in his

"Agriculture of Shropshire," published in 1803, described the sheep of that county thus: "There is a breed of sheep in Longmynd, with horns and black faces, that seem an indigenous sort. They are nimble, hardy and weigh about ten pounds to

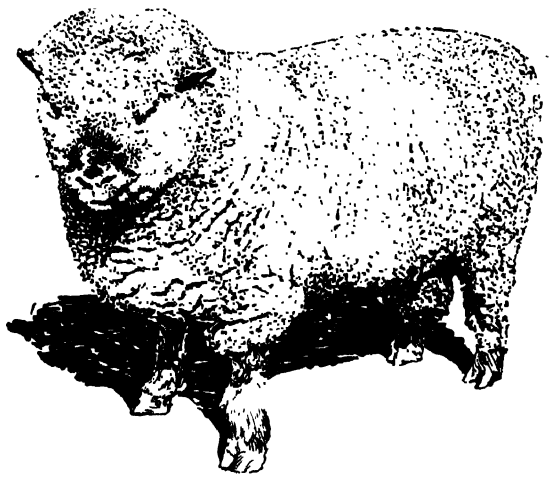

Fig. 630. Shropshire ram.

the quarter when fatted. Their fleeces weigh about two and one-half pounds." Professor Wilson, in his Journal of the Royal Agricultural Society, Vol. XVI, states that when the Bristol wool society, in 1792, procured all the information available regarding sheep in England, it reported that on Morfe Common there were about 10,000 sheep kept during the summer that had black, brown or spotted faces, a superior quality of wool, and were considered a native breed. These are accepted as the progenitors of the present Shropshires, although it is a common belief that the Southdown was used to hasten the improvement. It is thought, also, that the Leicester and Cotswold were used to increase the size and amount of wool, and that the sheep from Cannock Chase, in the county of Stafford, were used in the early breeding efforts. Samuel Meise, of Barrington, and George Adney, of Harley, were among the most successful of the early improvers. The Shropshire first attracted attention at the Royal Agricultural Society Show, in 1855; and in 1859 it was recognized as a distinct breed and given a class.

In America.—The first American importation on record was made into Virginia, in 1855. In 1860, Samuel Sutton introduced a number of ewes and a ram into Maryland. In 1862 and again a few years later, flocks were established in New York. They had also made their way into Canada, as they are reported to have been taken from Canada to Michigan in the early seventies. There was a great influx in the early eighties. The American Record Association was organized in 1884, at Lafayette, Ind.

Distribution.

The sheep are now recorded from almost every state in the Union and from Canada, and far exceed in numbers any other English breed in America. They are more popular in the North and East, not being extensively found on the ranges. They do best on good pastures, as their rustling qualities are only medium. They are found very generally throughout England and her colonies and, in fact, throughout the civilized world, especially in Europe, Africa, Australia and South America.

Uses.

Their good mutton form and quality and profitable wool production make the Shropshires the great American sheep after the Merinos, in their Delaine and Rambouillet forms. They have a much longer, more open and coarser fleece than the Southdown, are covered more extensively over the head and legs, and yield perhaps 50 per cent more wool. Ewes average eight pounds or more and rams twelve pounds of fleece. The fleece is of good fiber and carries considerable oil. They are also hardier than the larger breeds, although yielding to the Southdowns in this particular. The lambs may be profitably marketed at any time from five to twelve months of age, though usually the earlier they are marketed the greater the profit. The rams are very generally used on Merino and native ewes for the production of high-class mutton lambs.

Organizations and records.

In 1882, the English Shropshire Sheep Society was organized. The first volume of its flockbook was issued in 1884. The American Shropshire Sheep Association was organized in 1884, and had issued twenty volumes of its flockbook up to 1908. There is also a National Shropshire Association that has issued one volume of its flockbook.

Literature.

For references, see page 596.

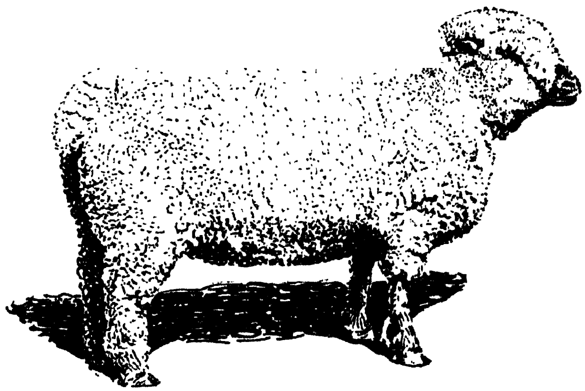

Fig. 631. Shropshire ewe.

Southdown Sheep. Figs. 51, 632, 633.

By *H. P. Miller.*

The name Southdown as applied to sheep arose from the use of the term in referring to the low range of chalk hills in southeastern England, in Sussex county, where the breed was developed. The date at which it was first used is not known,

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but in 1794, Arthur Young, in an essay, brought the breed into prominence. The breed ranks in the first place for mutton-production.

Description.

It is the smallest of the Down breeds that are prominent in America at this time, but it is the model in form toward which all other breeds are tending. Its compact form and short fleece, however, give it a weight greater than its appearance suggests. Mature ewes weigh up to 150 pounds, and rams up to 200, although average weights are somewhat below these weights.

In 1788, Arthur Young wrote: "The true Southdown, when very well bred, has no horns, a long speckled face, clean and thin jaw, a long, but not a thin neck, no tuft of wool on the forehead, which they call owl-headed, nor any fringe of wool on the cheeks, thick in the shoulder, open breasted, and deep; both fore- and hind-legs stand wide; round and straight in barrel; wide on the loin and hips; shut well in the twist, which is a projection of flesh on the inner part of the thigh that gives a fullness when viewed behind, and makes a Southdown leg of mutton remarkably round and short, more so than other breeds; thin speckled legs free from wool; the belly full of wool; the wool close and free from projecting or strong fibers. Those flocks not bred with particular care are apt to be coarse-wooled on the back."

The Southdown of today presents some contrasts to this: It is characterized by very short, straight legs, set wide apart; broad, level back, very thickly fleshed; long and broad hips, with tail setting very little below level of back; short neck, very thick at shoulder and sharply tapering toward head; the head small, but comparatively broad and flat between the ears; forehead full; face short and in ewes somewhat dished; eyes very prominent; ears small, carried above the level and covered, the English association says, with wool, while the American says with fine hair. The face and legs are now a uniform reddish brown, except some lingering white hairs about the nose. The face has a lively apperance, in keeping with the quick movements of the Southdown. The hind-quarters carry down very heavy; the twist is extremely deep and full; the breast very broad and prominent; both fore and hind flanks very full, thus giving an almost straight under-line. The hoofs are often black. They are of thin yet firm horn, making a good foot. There is now a large cap of wool on the forehead, and on many specimens the wool is working farther down on the legs. A bright pink color of skin is desired, and is uniformly found with healthy individuals. It may safely be said to be the hardiest of all the English breeds under American conditions and methods. It is freer from catarrhal troubles and does not so quickly succumb to the ravages of internal parasites. In these particulars it approaches the Merino. [A general discussion of the mutton type is given on pages 51, 52.]

The American Record Association adopted the following standard of excellence:

Scale of Points for Southdown Sheep

	Perfect score
1. **Head.**—Medium in size and hornless, fine, carried well up, the forehead or face well covered with wool, especially between the ears and on the cheek, and in the ewe slightly dished	5
2. **Lips and under jaw.**—Light and thin	1
3. **Ears.**—Rather small, tolerably wide apart, covered with fine hair and carried with a lively back-and-forth movement	2
4. **Eyes.**—Full and bright	3
5. **Face.**—A uniform tint of brown, gray or mouse-color	3
6. **Neck.**—Short, fine at head but nicely tapering, and broad and straight on top at shoulder	4
7. **Shoulders.**—Broad and full, smoothly joining the neck with the back	5
8. **Breast.**—Wide, deep and projecting well forward, the fore-legs standing wide apart	5
9. **Back and loin.**—Broad and straight from shoulders to rump	7
10. **Ribs.**—Well arched, extending far backward, the last projecting more than the others	6
11. **Rump.**—Broad, square and full, with tail well set up	6
12. **Hips.**—Wide, with little space between them and last rib	6
13. **Thighs.**—Full and well let down in twist, the legs standing well apart	6
14. **Limbs.**—Short and fine in bone and in color to agree with face	3
15. **Fore-legs.**—Well wooled and carrying mutton to the knee, but free from meat below	2
16. **Hind-legs.**—Well filled with mutton and wooled to the hocks, neat and clean below	2
17. **Belly.**—Straight and well covered with wool, the flanks extending so as to form a line parallel with the back or top-line	5
18. **Fleece.**—Compact, the whole body well covered with moderately long and close wool, white in color and carrying some yolk	12
19. **Form.**—Throughout smooth and symmetrical, with no coarseness in any part	9
20. **General appearance.**—Spirited and attractive with a determined look, a proud and firm step, indicating constitutional vigor and thorough breeding	8
Perfection	100

History.

The Southdown breed was developed through selection from the native Sussex sheep on the chalky downs of southeastern England. The native sheep were small, ill-shaped and coarse-wooled. About 1780 or earlier, John Ellman, doubtless taking inspiration from the success of Bakewell with the Leicester, began the development of the breed, striving for better mutton form and constitution, and at the same time to improve the fleece. He made rapid progress in fixing the present features of the Southdown. About 1820, Jonas Webb began breeding Southdowns with a selection from the Ellman and other flocks, and he proved to be the genius among the breeders. He built on Ellman's foundation, and produced this superior mutton sheep, of larger size and better feeding quality. The Southdown was thus the first of the Down or middle-wool breeds to be improved, and has been employed in the development of the other Down breeds, more particularly the Shropshire, Oxford

and Hampshire. It early became the breed of the English royalty and aristocracy, and remains so to the present time.

In America.—The first authentic importation into America was by Dr. Rose, of Seneca county, N. Y., in 1803. The sheep of this importation, however, were crossed with Merinos in 1813. In 1823, Sidney Hawes, of New York, made another importation and sold thirty-six ewes and two rams to C. N. Bement of Albany. In 183., Francis Rotch, of Otsego county, N. Y., imported six ewes and a ram from the Ellman flock. In the same year, Isaac Maynard, of Coshocton county, Ohio, made an importation. During the forties and fifties of the same century, while wool was very low and Merinos falling into disfavor, Southdowns became disseminated very widely. With the revival in interest in Merinos from the high prices for wool following the Civil war, Southdowns fell into disfavor, and because of their low wool-yield and the relative importance of wool in this country, they have not regained wide popularity in the North or on the ranges. South of the Ohio river, however, especially in Kentucky and Tennessee, they were for many years the prevailing breed, and are still popular.

Distribution.

The general adaptability and good grazing qualities of the Southdown, together with its superior mutton, have led to its wide dissemination. In America it has been especially popular in the Central-East and South, although it is found in practically every state and territory in the Union and in Canada. In South America it is found in Argentina,

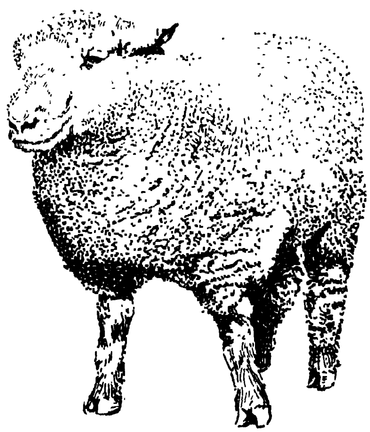


Fig. 632. Southdown ram.

Chili and other countries. It has been introduced throughout Europe, Asia, Japan, Africa and Australia.

Southdown rams prove highly satisfactory for mating with the long-legged mountain ewes for the production of mutton lambs. Pure-breds are also in favor for production of lambs to be sold at weaning time. The rams bred to Merino ewes produce highly satisfactory lambs for feeding off at eight to ten months of age. They produce a high quality of mature mutton, as they do not develop fat in bunches. The ewes are not suited

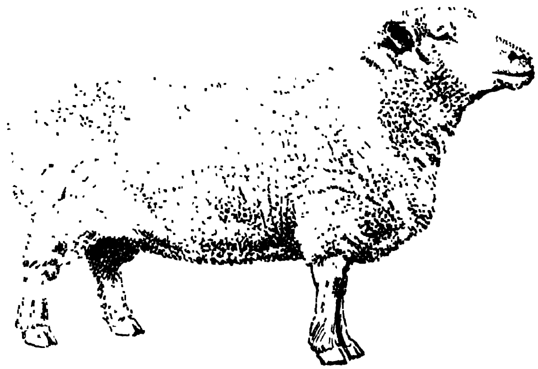


Fig. 633. Southdown ewe.

for growing winter lambs, as they will not breed at the right season, but the rams are very satisfactory for siring such lambs. The lambs are good feeders and mature rapidly. Single lambs are the rule, but a flock of ewes usually produces 125 per cent of lambs. Southdowns have rarely been known to produce triplets.

The Southdown has the shortest and finest wool of any of the Down or middle-wool breeds. The attempt has been to develop a fleece with a compact, smooth surface, that is without spiral tips on the locks of wool. The average weight of the fleece for ewes is about six pounds, and for rams about eight pounds. The wool grades as one-half and three-eighths.

Organizations and records.

English and American record associations were organized in 1882. The Southdown Sheep Society, with headquarters in London, had issued sixteen volumes of its flockbook up to 1908, and the American Southdown Breeders' Association, with headquarters at Springfield, Ill., had issued sixteen volumes of its flockbook. The latter has registered sheep from nearly every state in the Union

Literature.

For references, see page 596.

Suffolk Down Sheep. Fig. 634.

By *David McCrae.*

Suffolk sheep get their name from the county of Suffolk, England, where the breed was originally developed. They are a short-wooled mutton breed.

Description.

The Suffolk is a large, rangy sheep, black-faced, hornless, with long, clean, black legs. It resembles the Southdown in character and wool, but is about one-third larger in body and much longer in the leg. The wool is of good quality, of the clothing

type, and the mutton is excellent. It is a good feeder, and is reputed to be very prolific, yielding twins and triplets frequently.

Scale of Points for Suffolk Sheep	Perfect score
1. **General appearance.**—Pleasing outline, good carriage, and symmetry of development	7
2. **General form.**—Large in size, inclined to be long in body, medium strength of bone, somewhat cylindrical in shape, and straight above, below and in the rear	15
3. **Head.**—Medium in size, inclining to be long, and covered with fine, short, glossy, black hair to the junction with the neck; a small quantity of clean white wool on the forehead is not objected to; muzzle moderately fine, especially in the ewes; eyes bright and full; ears, of medium length and fineness	10
4. **Neck.**—Moderately long and well set, and blending well with the body, with some crest in the rams	5
5. **Fore-quarters.**—Well developed, breast wide, deep and full, brisket broad; chest capacious, with good heart girth; shoulders broad, oblique, and well filled in the neck and in the crops; withers broad; arm well developed	15
6. **Barrel.**—Roomy. Back straight, broad and well fleshed throughout its entire length; ribs well sprung and moderately deep; fore and hind flanks full and deep	15
7. **Hind-quarters.**—Long, deep and full; tail broad and well set up; buttock broad; twist full; thighs broad and full	15
8. **Feet and legs.**—Straight, of medium length, with flat bone; bare of wool below the knee and hock; glossy black in color and set well apart	8
9. **Fleece.**—Moderately short, with close, fine, lustrous fiber, and without tendency to mat or felt together or to shade off into dark or gray wool or hair, especially about the neck and tail. The fleece should cover the whole body, except the head and the legs below the knee and hock, and the skin underneath it should be fair, soft and of a pink color	10
Perfection	100

History.

The Suffolk is the modern representative of the old Norfolk breed, crossed with the Southdown. In some respects, the old Norfolk breed resembled the Black-faced Highland, having the same colored face and legs, with full bone, long spiral horns, long body, flat ribs, rather narrow loins. It differed from the latter in having very fine short wool. The mutton was of that fine, rich flavor that is found in many semi-wild animals. The great value of the old breed was its mutton, which, when long kept, more closely resembled venison than that of any other breed.

The Suffolk is the result of a cross between this old Norfolk breed and the Southdown, and shows what very important results may be achieved by able and enterprising breeders. The modern Suffolk is a conspicuous example of remarkable success in cross-breeding. By careful selection and management, the horns have disappeared. The Suffolk possesses excellent grazing qualities, and yields a carcass of lean, well-flavored mutton. Separate classes were first made for this breed at the Suffolk show in 1859, but it was not recognized by the Royal Agricultural Society until 1886.

In America.—The Suffolk may be considered a recent introduction to America. In 1888, sheep of

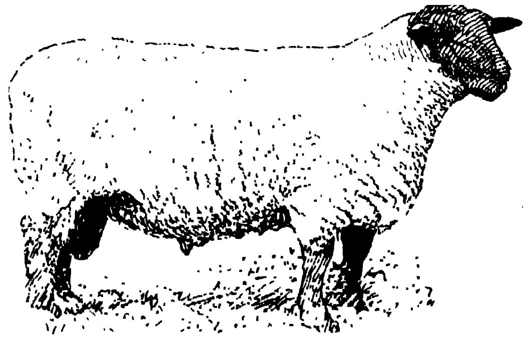


Fig. 634. Suffolk Down ram.

this breed were brought both to Canada and to the United States, the importation to Canada having been made by B. D. Sewell, of New Brunswick, and that to the United States by M. B. Streeter of Brooklyn, New York. They were taken to Iowa in 1892, and have since been established elsewhere.

The following is the scale of points adopted by the Board of Directors of the American Suffolk Sheep Record.

Distribution.

In England, the breed abounds in the counties of Suffolk, Norfolk and Cambridge. It has been exported to the continent of Europe, to Holland, Germany, France, Spain, Saxony, and elsewhere, where the rams are in demand to give a superior quality of mutton in their produce. It has been taken to South Africa, and Australia and New Zealand. It has been tried with success both in the United States and in Canada, but it is as yet relatively unimportant here.

Uses.

The Suffolk has a place as a mutton sheep, giving a large percentage of lean meat with a rich flavor. It is valuable for crossing purposes, to produce a quick-growing lamb of good quality, popular both with the butcher and with the consumer. The wool is well adapted for hosiery purposes, but is rather small in quantity.

Organizations and records.

The first English flockbook was published in 1886, by the Suffolk Down Sheep Society organized in that year. Some twenty volumes have been issued since. In America, the American Suffolk Flock Registry Association, organized in 1892, has issued the third volume of its flockbook.

Literature.

For references, see page 596.

Miscellaneous Breeds of Sheep.

There are a great many little-known (in America) breeds of sheep that are worthy of mention, as some of them have met special needs in special regions, and have qualities to recommend them. There are still others, such as the Welsh Mountain, the Lonk and the Shetland, that are of so little interest to farmers in America that they may safely be ignored.

BARBADOS OR "WOOLLESS" SHEEP. Fig. 635.

By *E. L. Shaw.*

This breed of sheep was imported by the United States Department of Agriculture from the island of Barbados, West Indies, in 1904. It is thought to be of African origin. It is hardy and very prolific. The ewes breed at any season of the year, and produce one to five lambs at a time. The young lambs are very attractive. The breed is of medium size and has somewhat of a deer-like appearance. The color varies from a light fawn to a dark brown. The under part of the body and the legs are very dark in color, almost black. The ewes are hornless and the bucks are usually so, but in some cases the bucks have small horns curving backward and downward. The rump is steep, the tail set low, reaching the hocks. The breed is practically without wool, the body being covered with coarse hair. The small quantity of wool is of very fine fiber. The hair has a decided crimp. The bucks have a very decided beard, which extends from the angle of the jaw almost to the brisket. This breed is considered to be valuable in warm climates for its mutton.

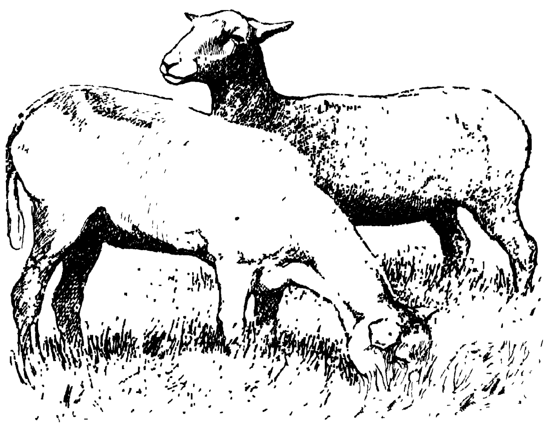


Fig. 635. "Woolless" sheep

BLACK-FACE HIGHLAND SHEEP. Fig. 3.

By *John A. Craig.*

This mountain breed of sheep is most commonly called "Black-Face," although in the effort to be more specific it is frequently referred to as the "Scotch Black-Face" or the Black-Face Highland. It is of medium size, with a bold, commanding appearance, added to somewhat by the fact that both the ewes and the rams have horns. The face is mottled or speckled, the fleece long in fiber and somewhat coarse. The chief point of merit is its thriftiness under conditions that would result in the extinction of almost any other breed of sheep. The mature sheep of this breed are very hardy and easily sustained. They subsist largely on heather and on the roughest kind of land, and withstand extreme exposure during severe storms. The newly born lambs share in this strength of constitution, and they are singularly equipped to undergo exposure by having a short, tight fleece cover them from heel to ear as soon as born.

The Black-Face may justly claim to be one of the oldest breeds of Great Britain; and being so, their early history is little known. It is commonly thought that they are the original stock of the country. The very earliest mention of these sheep is by a writer, Hector Boethius, born in 1470, who says that until the introduction of the Cheviot sheep, the rough-woolled Black-Face was the only kind known in the vale of Esk. The breed at the present time has been estimated to comprise about two-thirds of the sheep stock of Scotland, and one-third of the total sheep stock of the north of England.

They are mainly confined to this territory, for their importation to other countries or localities has not been very successful. Some have come to America, being first imported into New York state in 1861; but they have not been popular here.

Black-Face sheep are much used for cross-breeding, but no infusion of outside blood has been successful in improving them for their native conditions. In addition to their hardiness, they have other characteristics which adapt them peculiarly for the Highlands. They are not only capable of traveling long distances on rough ground in search of food, but they also have a peculiar "homing" instinct, based presumably on their strong attachments to certain parts of their grazing.

HERDWICK SHEEP. Fig. 636.

By *John A. Craig.*

This is one of the smaller mountain breeds, with the instincts and type of mountain sheep strongly developed. It has a heavy fleece of strong wool; head broad, nose arched or Roman, eye prominent and lively. Horns in the rams are desirable.

The tradition of the origin of these sheep is that they came from forty small sheep that escaped from the galleons of the Spanish Armada that were wrecked on the coast of Cumberland, making the ancestry Spanish. Macdonald says that in the beginning of the last century a ship was stranded on the coast of Cumberland that had on board some Scotch sheep, which seem to have been unknown in that country. The sheep were landed and turned on the neighboring hills. Their excellent qualities and adaptation to their new situation became speedily evident. Their fleece was considerably finer than that of the common black sheep, and the matted quality of the wool enabled them to endure any severity of weather, and even to pass the whole

of the winter without the smallest quantity of hay being expended upon them. By their ceaseless activity they scraped away the snow, however deeply the herbage might be buried under it.

Fig. 636. Herdwick ram.

These sheep are credited with living to a very old age, Macdonald stating that the ewes will breed for fifteen or twenty years.

In the English Lake country, the mountains of Cumberland and Westmoreland, in the north of England, these small sheep hold their own against the encroachments of all other breeds.

Persiacot and Persiarino Sheep

By *E. L. Shaw.*

The Persiacot is a cross between the Persian and the Cotswold breeds. This cross is said to be very hardy, and produces an excellent quality of mutton. The lambs make very rapid gains, and are in demand at good prices. The Persiarino is a cross between the Persian and the Merino breeds. This cross is said to produce a very hardy sheep and an excellent quality of mutton. All grades of these crosses are said to be fertile. The Persian (Fig. 3) resembles the Tunis, has a fat tail, and dark, hair-like wool. It has been used in a small way in the West for crossing.

Romney Marsh Sheep.

By *John A. Craig.*

This breed takes its name from the district known as Romney Marsh in the counties of Kent and Sussex, in the south of England, which has led also to its being spoken of as the Kent breed.

The Romney Marsh may be said to be one of the largest of the lowland breeds, likely being surpassed in weight only by the Lincoln. It has a white, broad face, and most frequently a tuft of wool on the forehead. It does not have horns. The native or original stock of the breed was large and coarse, but it is likely that the infusions of Leicester and Lincoln blood added both to its weight and improvement of appearance. The type is long and low, with comparatively thick legs and feet, and a strong-boned frame. The wool is long, comparatively fine, and the weight of the fleece from six and one-half pounds upward.

The special utility of the breed is its adaptability to low-lying lands which produce luxuriant feed, and will stand heavy stocking. The Romney Marsh may be run more thickly on such ground than any other breed, and continue thrifty. Under such conditions, it attains a large size and heavy weight, and the records of Smithfield and other British shows bear out the statement that it is rarely surpassed in the latter by any breed excepting the Lincoln.

Ryeland Sheep. Fig. 637.

By *W. L. Carlyle.*

The Ryeland breed of sheep originated many years ago in the midland counties of England. Its name comes from the Ryelands of Hereford, a poor upland district. The breed originated by crossing Southdown and Leicester rams on the old Morfe Common type of sheep, from which the Shropshire breed originated. In its blood lines it is similar to the Shropshire and the Morfe Common type of sheep, being leggy, with light fleece of wool and with a speckled black and white face. The Ryeland breeder selects the lambs with the white faces and legs, and the Shropshire breeder takes those with the dark faces and legs. The Ryeland is a very compact and hardy breed, and fattens very readily. In form, it is thick and heavy in the hind-quarters, with broad, level back, full round body, a little inclined to be coarse in the shoulders; short, well-set neck, and broad head, with some little wool covering on the head. It is set on short, straight legs. It is an active, vigorous type, filling the place in the sheep world midway between the Southdown and the Shropshire. Both the lambs and the ewes of the Ryeland breed are hornless, and the wool is finer in character, perhaps, than that of any of the other medium-wool breeds.

The first importation of the Ryeland sheep into America was made by Mr. George McKerrow, of Pewaukee, Wisconsin, early in the summer of 1907,

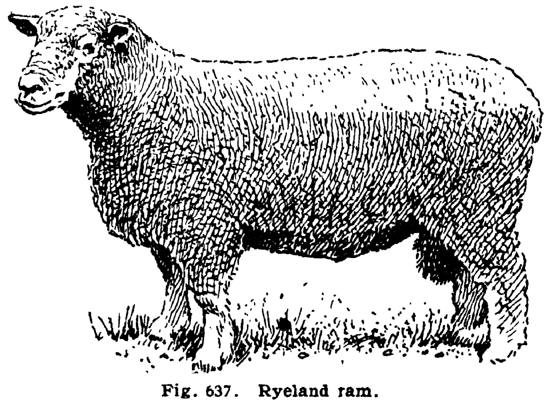


Fig. 637. Ryeland ram.

for the Colorado Agricultural College. The breed has been but a short time in this country, but it is excellently adapted for the mutton-producing sections of America. The lambs are dropped very

fat, and the ewes are wonderfully good mothers. They seem to cross well with both the Southdown and Shropshire types. The fleece of the Ryeland is not so heavy nor so dense as that of the Shropshire, but it is longer and finer in the staple.

TUNIS SHEEP.

By *David McCrae.*

Tunis is a province of North Africa, bordering on the Mediterranean sea. Much of the land is hilly. The fat-tailed sheep living in the upland region of the province are called Tunis sheep.

They are generally hornless; face and legs of a yellow-brown or tawny color; a few are brown or mottled brown and white. The tail is broad, being five to ten inches wide, and is usually docked to about six inches. The ears are large, broad, pendulous, and covered with fine hair. The fleece is soft, fine and fairly compact, about three inches long, and varies in color. One may have a fleece almost white, another reddish, and another mottled. Mature specimens weigh 120 to 150 pounds.

The origin of the Tunis breed is unknown. The type has no doubt existed in Tunis for centuries, and also in the adjoining sections of North Africa. Similar fat-tailed sheep are found in Syria and are supposed to be derived from a variety of the primitive race bred by the patriarchs and the early shepherds of Palestine and adjacent lands.

In America.—The introduction of Tunis sheep to America is said to date back to 1779, when the Bey of Tunis allowed General Wm. Eaton, then United States Consul at Tunis, to ship to America several "broad-tailed Barbary or Mountain Tunis sheep." Only one pair reached the United States. These were placed in the care of Judge Richard Peters, on his farm near Philadelphia, where they did well and increased in numbers. The original ram was afterwards used on the farm of General Hand, in Lancaster county, Pa. In 1807 or 1808, another importation was made by Commodore Barron of the United States navy. These were bred in Virginia and the District of Columbia. In 1825, another importation was made, some of which went to near Albany, N. Y. From the early Peters flock, these sheep spread into Georgia and South Carolina, and were common in the South before the Civil war, which nearly exterminated them. More recently Mr. Roundtree, of Indiana, has been a leading promoter of the breed. There are several flocks in Indiana and Ohio. In 1876, an American Tunis Sheep Breeders' Association was organized.

The Tunis as a mutton sheep has met with much favor. The lambs fatten early, and as the ewes will breed at various seasons they have been used to raise lambs for the Christmas market. Crossbred lambs are popular, as they are easily and quickly fattened and yield mutton of an excellent quality. As a wool-producer, the Tunis does not rank high. The color is objectionable, and the weight of the fleece is only six to eight pounds.

WENSLEYDALE SHEEP. Fig. 638.

By *John A. Craig.*

Being included among the lowland breeds, these sheep have the characteristics most common to sheep of that class, namely, large size, with long wool, thereby attaining heavy weights of both carcass and fleece. The Wensleydale is an upstanding sheep, similar to the Leicester in some respects, but with more style. The face and skin is of a bluish tinge, and this characteristic is encouraged, while in nearly all the other breeds a pink skin is sought, and the bluish tinge considered undesirable. The wool of these sheep is peculiar in that it is unusually lustrous, and is very wavy or full of "pirls," as they are called. It is long, strong, and comparatively fine, considering its length.

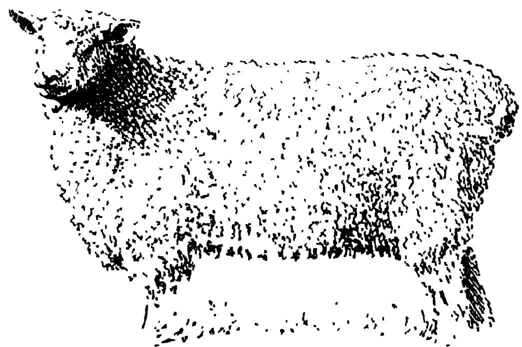


Fig. 633. Wensleydale ram.

The original stock of this breed seems to have been most prevalent in Yorkshire, and at an early day it was known as the Teeswater. The new name of Wensleydale Longwool was attached to it about the time the Yorkshire Agricultural Society began giving prizes for it, it being more common in Wensleydale than in any other district. Its origin seems to be akin to that of the old Leicester breed, and later infusions of Leicester blood undoubtedly have been made. The present type and characteristics have long been fixed, however.

The rams are used to cross on Black-Faced ewes, as it has been found that the cross-bred product makes a good feeding-lamb, and they have the additional desirable qualification of throwing dark-faced lambs.

The breed is confined closely to its native district, few having been exported to other countries. The most notable introduction of Wensleydale sheep to America was the importation made by the Wyoming Agricultural Experiment Station, which is said to be giving promise of valuable results. Aside from this, little attention has been given the breed in this country.

The Wensleydale has two societies and flockbooks devoted to it—the Pure Select Wensleydale Sheep Breeders' Association, with headquarters at Carperby, Bedale, England, and the Wensleydale Longwool Sheep Breeders' Association and Flock Book Society, with headquarters at Howgrave, Ripon, England.

SHELL-FISH. Figs. 639–644.

A shell-fish is defined as an aquatic animal, not a fish, having a shell, and especially one which comes under popular notice as used for food or for ornament. Specifically, the term is applied to the mollusks, represented by the oysters, clams, snails, slugs, squid and cuttlefish, and to the crustaceans, represented by the lobster, crayfish, shrimp, crab, and barnacle. The more common food shell-fish of the Mollusca are the oyster and the clam, and of the Crustacea, the crab, the crayfish, the lobster and the shrimp. These are given notice in this place. The general subject of fish-culture or aquiculture is treated on pages 390–394. Turtles, frogs and sponges, other aquatic animals, are discussed separately in their proper places.

The literature of shell-fish is largely in bulletin form. The publications of the national Bureau of Fisheries and of the state departments of fisheries should be consulted. A few publications are mentioned here. Frank R. Wood, The Shell-fisheries of New York State, Forest, Fish and Game Commission, Albany, New York (1904); Same, Shell-fish Culture in New York (1906); Report of the Bureau of Shell-fisheries, State of New Jersey, Trenton, N. J. (1905); Annual Reports of the Biological Department of the New Jersey Agricultural Experiment Station, New Brunswick, New Jersey. In this connection, the reader should consult, especially, the Reports of the United States Bureau of Fisheries for 1893, 1897, 1899, 1903 and 1904, and bulletins of the same for 1884, 1889, 1897, 1898 and 1904. On the Giant Scallop fishery, see the bulletin of 1889.

Clam. *Mollusca.*

By *Julius Nelson.*

Of the various edible bivalves of our coast, including the scallops, the mussel (*Mytilus*), the hard-shelled clam (*Venus mercenaria*), and the soft-shelled clam (*Mya arenaria*), the last two, and particularly the last one, have been the subject of experimentation, with the object of learning the principles of their cultivation. As yet, the only progress has been to imitate primitive oyster-culture, viz., to secure the young as "seed," and to plant them in favorable localities not already stocked.

The spawning period, the reproductive products, and the development of the egg are much as in the oyster (which see). The young clams resemble the young oysters in becoming fastened to objects, but instead of cementing themselves fast by one of the shell-valves, they develop a sticky, tough thread, called a byssus, like that which anchors the mussels. They also develop a plow-shaped, muscular projection back of the mouth, known as a "foot," by means of which they burrow into the soil at the bottom of shallow areas, generally between tide marks on the beach. They require a tenacious bottom or else they will be smothered. At the posterior end, the mantle grows out as two tubes (known as "siphons"), called the "neck" of the clam. The ventral tube is for the inhalation of water containing the air needed for respiration, and the microscopic food needed for growth; the dorsal tube exhales the water, after it has traversed the pores of the gills. These siphons project upward through the soil toward the water. If the young clam finds a suitable place, it remains there permanently. Often the young are very much crowded and many starve to death; then others die from the decay of their neighbors. Thus there is an advantage in transplanting. In a year or two a marketable size will be reached on good ground.

The New England coast is the principal home of the soft clam, while the middle Atlantic states produce the hard clam. The total catch marketed in 1904 exceeded one and a half million dollars in value.

Crab. *Crustacea.*

By *Julius Nelson.*

In 1904, over 40,000,000 crabs were marketed in the United States. The chief center of the crab fishery is in the Chesapeake bay, near Crisfield, Maryland. The fishery began in 1875, and at first was confined to the capture of soft-shell crabs, i. e., those that have just shed their shell; but later the taking of hard-shell crabs developed. The latter are either sold alive, or boiled, the meat extracted and put up in sealed cans or in buckets surrounded by ice. In the latter case, the shells are cleaned and shipped in the same crate with the meat, to be used in serving "deviled" crabs. The soft-shell crabs are shipped alive, closely packed. The fishermen get two cents each, and the shippers about four cents. Hard crabs are worth less than a fifth as much.

Soft crabs are taken either by hand nets from small boats, or by dredging from larger boats, usually carrying a dredge on each side. Hard crabs are taken on baited lines. Crabs that have not yet shed, but "show signs," are put into floats, where the shedding is completed; and this is really all that can properly be termed "culture" in connection with these shell-fish. Practically, only the blue crab (*Callinectes hastatus*) is involved.

The females are mature at three or four years of age, and are said to spawn but once and then die, while the males survive several years. The majority spawn in the early spring, and their young are hatched the same summer; those spawning in the late autumn carry the eggs over winter, going into deep water. The female molts before spawning, and as the molting time approaches, she is seized by the male and carried about. After shedding, and while the shell is still soft, copulation is effected, lasting a day or two. Then the female seeks deeper water and produces about three million eggs, each a hundredth of an inch in diameter. The young hatch in the form of zœas that molt several times, becoming transformed to a stage called megalops, which in turn become transformed into the adult form after six molts. Then the young migrate toward the shallow shore waters.

Crayfish. *Crustacea.* Crawfish. Figs. 639, 640.

By *E. A. Andrews.*

It is not generally known that the sales of crayfish in the United States amount to more than $25,000 annually, so extensively are they used as food and garnish, as bait and as subjects for study.

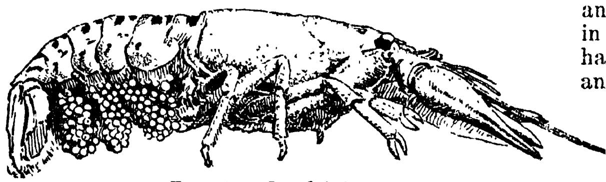


Fig. 639. Crayfish bearing eggs.

While the supply of wild crayfish seems at present adequate to meet the demand, there is no doubt that from the increase in our population and the over-fishing of crayfish haunts, the demand will come to exceed the supply, as has been the case in so many departments of natural food supply.

In France and in some other European countries, crayfish-farms for hatching, feeding and rearing crayfish for market have long been conducted in successful competition with the natural supply. The crayfish in America are so much like those of France that the same general methods of culture will apply, as has been demonstrated by experiment at the Johns Hopkins University.

Of importance for experimental culture of crayfish in this country is the fact that America possesses a very large number of kinds of crayfish of different market values, and that some are very large so that they might fill the place left by the fast-disappearing lobster. A fundamental fact of importance in crayfish-culture is that these animals are easily fed, at all periods of their lives, on cheap vegetable and animal matter. Where there is easy access to large cities having a good market for crayfish as food, experiments on the introduction and culture of large and attractive kinds, such as the crayfish of Oregon, would seem to be well worth trying, with the expectation of adding to the revenue from cheap pond and marsh land.

Points to be observed in crayfish-culture.

To rear crayfish it is necessary to have shallow ponds that may be easily drained and protected from large fish and other enemies of crayfish. The common crayfish breeds in the spring, and when found carrying eggs, or "in berry," as shown in Fig. 639, it may be removed to a special pond where the young will hatch, and as minute crawling larvæ receive special care and food during their first summer. In the first autumn the young should be two inches long. In the winter the crayfish require little attention, as they are inactive and do not grow. But in the summer the growth is accompanied by shedding of the shell, and good feeding will induce rapid growth. In large enclosures the natural vegetable and insect food will support many crayfish, but in smaller ponds and rivers, soft vegetable and animal food must be given.

Too great crowding is to be avoided, as parasites and disease may destroy large numbers. In fact, in Europe, epidemics caused by certain bacteria have destroyed the crayfish in large river areas, and attempts are in progress to restock with American crayfish.

Since each female crayfish lays several hundred eggs each year for several years, and may begin to breed when less than one year old, a rapid increase in stock may be secured simply by protecting the mothers with eggs, and lessening the naturally large death rate among the young by keeping away enemies and giving plenty of food.

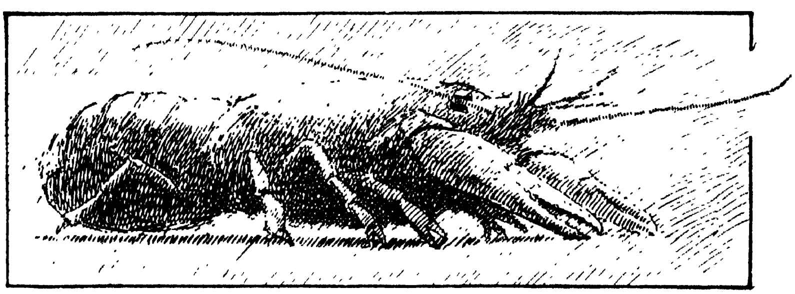


Fig. 640. Crayfish reared from eggs in captivity. Twenty-five months old.

Lobster. *Crustacea.*

By *Julius Nelson.*

Experiments in the artificial propagation of lobsters have been conducted by the United States Bureau of Fisheries since 1888, and more particularly since 1894. In 1900, along the coast of the New England states, there were employed in the lobster fishery 4,348 persons, 191 vessels, 3,960 boats, 208,563 lobster pots or traps, involving a total investment of $1,668,000. There were taken 15,767,741 pounds of lobsters, which sold for $1,390,579. [United States Fish Commission Report for 1903.] This shows a decline in the production, the yield eleven years earlier having been twice as great, of which 25,000,000 pounds were produced by Maine alone. Outside of New England waters, the lobster production of our coast is unimportant. With decrease in production, the price has trebled.

The lobster spawns not oftener than once in two years, and carries its eggs attached under its abdomen, popularly called the tail. Such females are then said to be "in berry." The eggs are carried through the winter, the lobsters going into deep water, and are hatched the next spring. As with the crab, the adult probably casts its skin, a process called "molting," before it lays the next crop of eggs. The young, when hatched, are a third of an inch in length, and they seek the surface. They

grow, with frequent molts, until nearly an inch in length; then they seek the bottom. In approximately four years they are eight inches long and produce their first batch of eggs, about five thousand in number.

For artificial rearing, the eggs are removed in the early summer from "berried" females and hatched in floating crates, covered with cotton scrim. Hatching begins in June, and the larval moltings, six in number, consume nine to twenty-five days, according to the temperature (70° to 60° Fahr.). There is great mortality among the young, principally from a fungus, the growth of which can be restrained by the use of copper netting. The larvæ eat lobster and crab liver and crushed menhaden, but not the flesh of herring or beef. The best results come from feeding natural plankton (see page 393), but the mortality is very great. It is still a question whether the mortality under nature is greater or smaller than under artificial conditions. But if the eggs of lobsters that are caught can be saved, evidently natural methods will be supplemented. Laws prohibiting the taking of "berried" lobsters should prove the most efficient means of preventing depletion. At the end of the larval period the young lobsters are turned into the sea to shift for themselves. They do not wander far, and so particular regions can be stocked.

Oyster. *Ostrea* spp. *Mollusca.* Figs. 641–644.

By *Julius Nelson.*

The oyster industry has been considered a fishery, but it attains its best development through the application of aquicultural methods. Its interests are in charge of the United States Bureau of Fisheries, state fish commissions, or of special oyster and shell-fish commissions. In 1902, the United States produced nearly twenty-six million bushels of market oysters, about five-sixths of the world's product, worth at first cost $15,566,805. More than a third of the product came from the Chesapeake bay.

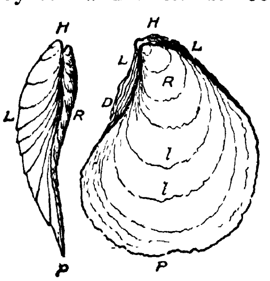


Fig. 641. Left: Oyster-shell viewed from dorsal edge: *H*, hinge end (anterior); *P*, "nile" end (posterior); *L*, left valve; *R*, right valve. Right: Oyster shell viewed from upper (right valve) side; *D*, dorsal edge; *l*, *l*, lines of growth.

Species.

The following species are commonly cultivated: *Ostrea lurida*, native of the Pacific coast from British Columbia to California; *O. cuculata* of Japan; *O. edulis* of Europe, from the North sea to Italy; *O. Adriatica* of the eastern Mediterranean; *O. angulata* of Portugal and southern France; *O. Virginiana*, the common oyster from the gulf of St. Lawrence to Texas, but now exterminated between Nova Scotia and Cape Cod; the native oyster north of the Cheaspeake is variety *borealis.* Other species are found on the coasts of Mexico and the Antilles. *O. edulis* is hermaphroditic and viviparous. *O. Virginiana* and *O. angulata* are diœcious, each individual being either a female, producing "roe" (ova), or a male, producing "milt" (sperms). They are oviparous, the reproductive cells being emitted to conjugate while floating in the surrounding water, where the entire development proceeds.

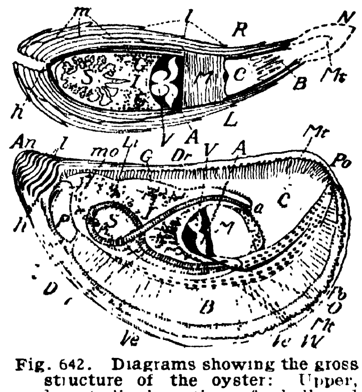


Fig. 642. Diagrams showing the gross structure of the oyster: Upper, longitudinal section of shell and contents; lower, view from the left side, the soft parts lying on the right "half-shell." *h*, Hinge ligament; *m*, points of attachment of the muscle in previous seasons; *l*, edges of the shell of previous seasons (lines of growth), *N*, "nile," or posterior end, *Mt*, edges of mantle; *B*, gills; *C*, cloacal chamber; *M*, adductor muscle; *A*, auricle of heart; *V*, ventricle; *G*, reproductive tissue; *I*, intestine; *S*, stomach; *L*, left (lower) valve; *R*, right or upper valve; *An*, anterior end, *Li*, liver; *Dr*, dorsal edge; *Po*, posterior end; *O*, opening for the exit of "spawn"; *Ve*, ventral edge; *P*, lips; *mo*, mouth, *D*, first part of intestine; *a*, vent of intestine; *W*, water tubes, opening from gills into cloacal chamber

Reproduction.

The eggs of *O. Virginiana*, the common eastern oyster, are one five-hundredth of an inch in diameter, which is thousands of times larger than the sperms. The roe and milt, about equal in amount in the two sexes, are indistinguishable to the naked eye, appearing, when mature, as a creamy layer beneath the skin in front of the heart. The ejection of the milky fluid is called spawning, and the reproductive fluid is called spawn. The height of the spawning season is reached by the last week in June. The length of the season depends on the temperature of the water. The optimum temperature for spawning is about 80° Fahr. In Long Island Sound, spawn is not visible in oysters before May or June, nor after August or September, but in Florida waters oysters may also spawn at Christmas time, and have been known to reproduce in February. Oysters probably repeat the spawning act several times during the season, especially in the South.

The reproductive cells grow at the expense of nutriment stored in the connective tissue, and hence oysters are very lean just after spawning. If food is abundant, they soon recuperate. When the cooler weather of August and September comes, they store up fat to be used for reproductive purposes the following summer. Hence it is that oysters are most relished in the months with an "r," which constitute preëminently the oyster season. Oysters also spoil readily in warm weather. An oyster filled with spawn contains as much nutriment as ever; it has a poor flavor when eaten raw, but is greatly improved by cooking. There is a limited summer trade in such oysters at coast resorts, and in nearby cities.

Development.—The eggs of the oyster are fertil-

ized within a few minutes after reaching the spermatized water, and development follows rapidly and normally at temperatures between 60° and 85,° the optimum lying between 68° and 78°. In five to seven hours the egg has completed its segmentation and becomes a ciliated, free-swimming larva in the gastrula stage. It is scarcely larger than the egg, and has a ciliated stomach cavity less than one two-thousandth of an inch in diameter, so the food consists of only the minutest of algæ spores and microbes. Growth is slow at first, but the mantle-folds are formed, and the primitive shell secreted by the end of the first day. The valves are alike, resembling those of a clam. The embryos may now be called oyster "fry." They swim awkwardly by means of a ciliated velar disk protruding between the valves. They are distributed by means of tidal currents, their limited swimming powers being used at first to change their vertical distribution while floating, and finally to secure a location on an object suitable for their attachment. Such objects are called clutch or collectors, and consist of the shells of oysters and other shell-fish, dead or living: but grass, bushes, trees, posts, rocks, pebbles, pieces of crockery, glass, bricks, boats, leather and rubber boots are readily utilized. The clutch must be clean, not coated with slime, for the fry at this time are each less than one one-hundredth of an inch in diameter. After fixation, the baby oyster is called spat. The length of time the fry swims free has been variously stated as being from one to seven days, depending on temperature and food conditions, but it is certainly not shorter than five days, and often more than seven.

Attachment is made by the left mantle edge, and growth is so rapid that the spat becomes visible to the naked eye within three days. Young oysters reach an inch in diameter in two months, and then, as cold weather comes, the growth is arrested. When a year old they average two and one-half inches. A second year adds little more than an inch, as the increase lessens with age.

The food of the oyster consists of microscopic organisms floating in the water, belonging mainly to the vegetable kingdom. The algæ, called diatoms, constitute nine-tenths of this food.

Natural oyster beds.

Under natural conditions, the successive generations settle on the shells of their ancestors. Eventually the oldest generations become buried and smothered in the accumulating mud, and finally a reef is formed whose surface reaches the average level of low water. Such reefs lie near the shore, with a deep channel beyond. Natural beds may also form in deeper water. The living oysters on the top of reefs are so crowded that an acre may yield eight thousand bushels. But they are mostly poor oysters of all sizes, and are lean through competition for food, and few are fit for market. Near the reef and in adjacent coves are isolated specimens in good condition. Reef oysters transplanted to certain grounds, not naturally oyster-producing, grow and fatten rapidly.

There are nearly 600,000 acres of so-called natural oyster ground in the United States, distributed principally as follows: Connecticut and New York, 35,000; New Jersey, 90,000; Delaware, 70,000; Maryland, 123,000; Virginia, 250,000; North Carolina, 10,000; South Carolina and Georgia, 2,000; Florida, 12,000; Alabama, 2,200; Louisiana, 32,000. Only a tenth of these areas is actually productive in some of the states, but these grounds at present yield over half of our supply. They will require special attention to prevent their disappearance.

Oyster-fishing.

Oysters are taken by tongs and by dredges. (Fig. 643.) The right to take oysters is usually permitted only to residents who pay a yearly license. Dredges operated by steam may not be used, and dredging in water so shallow as to allow the use of tongs is prohibited. Operations are forbidden at night, on Sundays and during the spawning season. The duration of the closed season is generally from April or May to September or October, although it varies.

Tongs and dredges gather indiscriminately empty shells, oysters of all sizes, and clusters that must be knocked apart. Sorting out the marketable oysters is called culling. The shells and small oysters remaining, formerly were sold at two to four cents a bushel for burning into lime. They

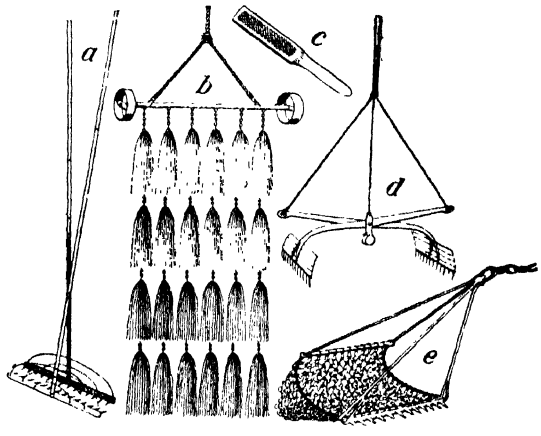


Fig 643. Outfit for oyster-gathering. *a*, Tongs for water less than twenty-five feet deep; *b*, 'tangles,' to be drawn over oyster-beds to entangle star-fish in the mops; *c*, knife for opening oyster shells; *d*, deep-water tongs; *e*, dredge for scraping oysters from beds in deep water.

have also been used extensively for filling and road-making. Excessive fishing leads to denudation of the reefs and a decrease in the size of the oysters, until at last only the crop spawned the previous season is present. Then the bed is said to be depleted, and produces only seed for the planting grounds. Finally, all the clutch is removed and the bed is destroyed. To protect the natural oyster beds, various regulations are in force.

Planting ground.

Outside the limits of natural oyster ground, opportunity has been given for the development of

private oyster-planting. Such grounds are sometimes secured under a title that permits their sale and transfer by inheritance. The market value of the best ground is above a thousand dollars an acre, although the average is thirty dollars. The grounds are taxed, or a rental may be charged for land leased from the state.

The area of leased land in the United States is about 360,000 acres. Ten times this area is available for future expansion, aside from the natural ground, which, if it came under cultivation, would yield thirty times its present product. Only a third of the leased area is actually under cultivation. The amount one person may hold is sometimes limited. The largest oyster farm (7,000 acres) is owned by a firm in Connecticut.

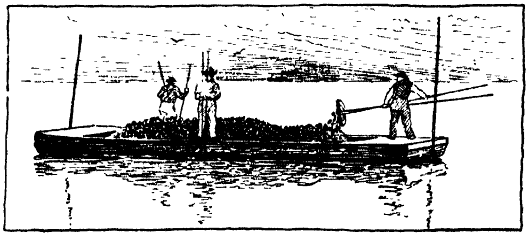


Fig. 644. Tonging oysters into a scow.

It is advantageous to shift oysters to new ground in the spring or autumn, and it is good policy to let a plot lie fallow for a year after the crop is removed, in order to disperse enemies that have gathered. As it requires three or four years for seed to grow to market size, the annual crop is produced from only a fourth of the ground occupied.

About three hundred bushels of average young seed, costing twenty to forty cents a bushel, may be planted per acre. Under favorable conditions, this will have increased threefold when ready for market. Usually the planter is content to gather nearly the same quantity as was planted, the oysters having become enhanced three to four times in value. Young seed doubles in growth the first season, the losses during the next balance the increase, and thereafter the death losses overbalance the growth. The average annual net profit is about 10 per cent on the investment.

Oyster-culture.

Oyster-culture has developed through several stages of progress by the pressure of circumstances. So long as the natural beds yielded a sufficient supply of choice oysters, there was no culture. The first step was to transplant adult oysters for the purpose of improving their flavor and fatness. As demand increased, the supply of natural adult oysters gave out, and it became necessary to take the second step, i. e., to cultivate small oysters. The areas furnishing this seed in the vicinity of planting grounds in turn became overtaxed. The northern planter was forced to seek seed in Chesapeake bay, where, at first, it could be secured in unlimited quantities at ten to twenty cents a bushel. In the spring of 1880, a fleet of fifty vessels was carrying nearly two million *bushels of seed from Maryland to be planted in northern waters. Finally, the affected southern states, to protect their own supplies, prohibited* the export of seed oysters. This would have been a serious blow to the planting industry had not another step in the progress of oyster-culture been taken, viz., the raising of seed on private grounds.

Artificially produced seed.—In 1868, Capt. Chas. H. Townsend of New Haven, Conn., following a suggestion from European methods, spread oyster shells on his own grounds and secured a good "set" of spat. This practice gradually developed into a great and successful industry. A single firm annually planted a quarter million bushels of shells. This seed is either raised to adult size by the producer or is sold to other planters. Of the 6,879,405 bushels of seed oysters sold in the United States in 1902, one-fourth was raised on private beds in Long Island Sound.

The amount of clutch used per acre is about five hundred bushels, but if the bottom is soft, as much as two thousand bushels may be necessary. The clutch rapidly becomes slimy in the water, and so is generally not planted until the last week in June or the first week in July, when there are the greatest number of fry ready to "set." If the "shelled" ground is not reached by currents flowing over oyster-beds containing suitable spawners, about thirty bushels of adult oysters should be planted per acre, at least several months before the shells are spread, as handling oysters during the spawning season interferes with the proper formation of their spawn.

Artificial propagation.—It was supposed that the reproduction of the American oyster, *O. Virginiana*, resembled that of the European oyster, *O. edulis*, until 1879, when Dr. W. K. Brooks, of Johns Hopkins University, succeeded in raising oyster fry by artificial fecundation. This discovery gave hope that we would be able to devise a method of multiplying oyster seed at will in unlimited quantities. The next dozen years witnessed extended experimental studies of the problem by many eminent fish-culturists. The general method used by these investigators is as follows: During the spawning season, oysters are opened and those filled with spawn are chosen. Their spawn is examined microscopically, until two or three "ripe" specimens of each sex are secured. A very small amount of spermatic fluid is added to clean sea-water, and to this the carefully washed eggs of the female are added. Development readily follows, and after a few hours the surface of the experimental dish is crowded with swimming embryos. These are now poured into new sea-water and can be kept several days, but are best planted when their shell is perfectly formed on the second day. Development is frequently abortive, due to errors of manipulation, faulty conditions or evil influence affecting the mother oyster. Oysters should be opened immediately after they are taken from their beds. The fry is planted in an enclosure suited to prevent its floating away; and by means of introduced clutch, observations are made on spat

fixation. Certain essential principles governing spat fixation are still to be discovered.

European methods.—In Europe, the natural beds are specially protected by the government. Their main use is to furnish spat for artificial collectors placed on adjacent grounds. These collectors are curved tiles. They are coated with plaster and cement and are put into position as soon as inspection shows that spawning has begun. This industry (of securing spat in this way) is in the hands of private parties, who pay rental to the government. Many of these tiles are on ground exposed at low water. They are frequently inspected and rinsed from sediment. In autumn, when the attached spat has reached the size of a finger-nail, the tiles are removed from the producing ground to the rearing ground. In Holland, they are submerged in diked ponds to keep them from freezing; toward spring, the young oysters are carefully detached by thrusting a thin knife beneath the cement. The young plants are then placed on special growing grounds.

In France, a more complex method employed. The spat are collected by specialists who sell the tiles in October to others, whose special work is to continue the cultivation. The spat are detached at once and put into "elevage" boxes, provided with wire screens to keep out enemies. The boxes are placed in ponds or *parcs*, in which they are daily submerged by the tides. The largest oysters are sorted out from time to time and transplanted to other ponds. Special fattening ponds, called *claires*, are so constructed that only the highest or spring tides can enter when permitted by the opening of a gate.

In early summer these ponds are allowed to become dry; the bottom is carefully tilled, and a small amount of water, both from the sea and from fresh-water streams, is allowed to enter. Under the hot sun, the algoid organisms present multiply greatly. Then the pond is allowed to fill, and the water to stand stagnant. In this the oysters are placed in September for two or three weeks. They fatten rapidly, but through want of sufficient air, many die. The *claires* of Marennes are noted as giving a green hue to the oysters placed therein. The oysters are removed from the fattening *claire* into clear, well-aërated sea-water for a few days for the purpose of cleansing. Finally they are prepared for market by being placed in ponds, where they are exposed the greater part of each low tide. This accustoms them to hold their shells shut during transport.

At Tarente, Italy, twigs entwined in grass ropes suspended from posts are used as collectors. In Japan, bamboo branches or *shibi* are set on the bottom in rows or in clusters; and when the tide is out, an oyster-garden resembles a vineyard. The *shibi*, loaded with oyster fruit, are themselves transplanted into culture plots in deeper water. By this means the growth of three years equals that of four when the oysters lie on the bottom.

In America, the cost of labor prevents our giving the oysters the individual attention they receive in foreign lands. Oysters grow rapidly in natural or artificial tidal ditches in our salt marshes, so that we may expect soon to see these vast areas made productive through proper ditching. It is a general practice among American oyster-producers to prepare their crop for market by a process called plumping, freshening or fattening. The laden boats returning from the planting grounds are unloaded at high water in a fresh-water creek. As the tide runs out, the oysters absorb water of decreased saltness, and swell about twenty-five per cent in volume. The oysters are removed at low water and prepared for shipment. After they are opened most of this extra water becomes squeezed out as "liquor."

Marketing.

Oysters are shipped in the shell, to be opened elsewhere, in sacks or in barrels holding two and a half to three bushels. They are sold by the thousand. Small oysters, not over three years old, are called culls. They run from 1,000 to 1,500 per barrel, and are worth to the producer about $2.50 per thousand. Oysters running 650 to 1,100 per barrel are "box sizes," worth $5 per thousand; larger sizes are "primes," and the largest are "extras." These prices should be doubled for "eastern" oysters cultivated in California. Since 1894, about 9,000 barrels of seed from Newark and Raritan bays have been sent annually to be planted in San Francisco bay, where it competes with native oysters (*O. lurida*) imported from Washington state. Over a hundred thousand barrels of oysters in the shell are annually sent from Long Island Sound waters to Europe.

Shucked oysters.—As the shells are dead weight, there arose the practice of opening oysters near the locality of production and shipping the meats packed in "preservalene" or ice in tubs. This began in New Haven, Conn., in 1836. At first, oysters were transferred from the South to be opened in the North, but shucking houses were started in 1850 in Baltimore, and later at Crisfield and other Maryland points, Norfolk, Virginia, and Seaford, Delaware. In 1880 nearly four million bushels were opened in Baltimore. In 1897, all Maryland houses together opened less than five million gallons. Lately there has been more rapid decline, while packing-houses have started on the gulf coast.

Canning.

In 1846, the industry of oyster-canning was initiated. Small oysters are used. They are first killed by steaming so that they can be rapidly opened. After packing, the can is sterilized. In 1880, three million bushels were steamed in Baltimore, which still held a monopoly of this trade. In 1897, over twenty-five million pounds were canned in Maryland, but, owing to scarcity of oysters, this trade has now passed to the states farther south. In 1900, Maryland produced only a third of the thirty-three million pounds of oysters canned in the United States; Mississippi produced another third, and the other southern states the remainder. The canning-houses are engaged in canning fruit in the summer. According to the

census of 1900, there were thirty-nine oyster-canning houses in the United States.

Literature.

Ernest Ingersoll's memoir on the "Oyster Industry," written for the Census of 1880, is classic. United States Fish Commission Report for 1892 gives a bibliography of oyster publications in English, including 546 papers by 278 authors.

Shrimp. *Crangon vulgaris. Crustacea.*

By *Julius Nelson.*

Practically no effort has been made to assist nature in the production of shrimp. The chief shrimp fisheries are on the Gulf and Pacific coasts of America. The annual catch is about four hundred thousand dollars' worth, a fourth of which may be credited to San Francisco bay. These shrimps or prawns are canned. An unknown number are used for bait all along the coast.

SILKWORM. *Bombyx mori*, Linn. *Bombycidæ.* Figs. 645–649.

By *L. O. Howard.*

The cultivation of the domestic silkworm for the production of raw silk, subsequently to be made into cloth, seems to have originated in China, and as an agricultural industry is of very great antiquity both in China and in India. The ancestral form of the silkworm of commerce was probably a native of the northern provinces of China or of Bengal. It was, as a wild species, probably a full-winged, flying moth, whose larva was of a dark color, and spun a much smaller and less dense cocoon than does the silkworm of today. After countless generations of confinement, cultivation and breeding, however, the insect has become a true domesticated animal; the moth has practically lost the power of flight; the larva or caterpillar has become for the most part nearly white in color, except in certain rather aberrant races; the silk glands have become very large, and the silk has become most excellent in quality and very abundant.

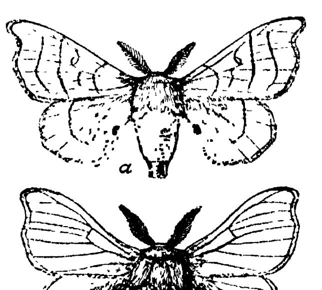


Fig. 645. The moth. *a*, the male; *b*, the female.

Life history of the silkworm. (Figs. 645–647.)

The silkworm of commerce passes the winter in the egg stage, and with most of the races there is but one generation each year. With certain other races there may be two or more generations, but in most silk-growing countries these are not extensively cultivated because of the difficulty of securing food of the right quality at other seasons than late in the spring and the beginning of summer. In Japan, however, the great increase in the silk industry during the past thirty years is said to be due to improved methods of feeding, so that three crops of worms may be fed annually. This, however, is not done by the use of the varieties having several

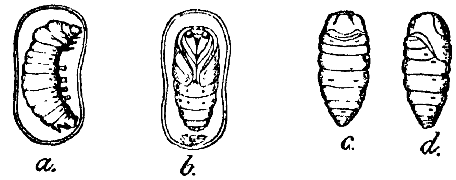


Fig. 646. The chrysalis: *a*, silkworm completing its cocoon; *b*, cocoon and chrysalis—cast of skin of larva beneath; *c*, back view of chrysalis; *d*, side view of chrysalis. (Redrawn from Maillot.)

generations (bivoltins, trivoltins or polyvoltins), but by the use of an annual race, and the cold storage of the eggs, part of which are removed at intervals and the worms reared. Under ordinary conditions, such as exist in America and in South Europe, the eggs hatch naturally in April; the larvæ molt four times, feed for about four weeks, and then spin the cocoon, taking about three days for the process. About eighteen days elapse in the chrysalis stage within the cocoon, and then the adult insect emerges. The moths will lay their eggs about the end of June, and in this condition the insect remains until hatching time the following spring.

Care of the silkworm.

It is not necessary here to give a full account of the care of the silkworm. It is a more or less complicated process, and involves a full consideration of temperature, ventilation, certain essential implements, character of the trays and tiers of trays, the picking of the mulberry leaves, the absence of moisture on the leaves, and many similar facts, together with the preparation for spinning, and the care and harvesting of the cocoons. The operations, however, are not such as require necessarily any high degree of intelligence. Children may become accustomed to the culture of silkworms, and may practice it with success. The labor of caring for a comparatively small number of worms (say four or five thousand), is not great, except in the later stages of growth. Then, to keep them full-fed will occupy the temporary services of an adult in the collection and distribution of the large amount of leaves required for food. All of these details are displayed in publications of the United States Department of Agriculture, which will be sent to all persons on application; these publications also consider the care of the mulberry tree, together with the important matter of the diseases of the silkworm.

History of the industry.

For many hundreds of years the cultivation of the silkworm was confined to Asiatic countries. It seems to have been an industry in China as early as 2600 B. C., and was not introduced into Europe

until 530 A. D. After the latter date the culture rapidly increased, and soon became prominent in Turkey, Italy and Greece, and has held its own in those countries, becoming of great importance in Italy, and achieving a considerable rank as an agricultural industry in France, and less so in Spain and Portugal. Silk-culture has also been practiced to some extent, but with slight comparative success, in parts of Germany, and recently with rather favorable results in Hungary. Attempts to establish the industry in England, although made from time to time, have failed. Silk-culture has held its own in China, is still in vogue in India, and in Japan has made great strides. The latter country today produces a very considerable proportion of the world's supply of raw silk. Thus, of the forty-one millions of dollars spent by the United States in 1902 for raw silk, more than twenty millions went to Japan. [See page 643.]

In America.—With the colonizing of North America, attempts were made at an early date to practice silk-culture, and the colonists of Virginia,

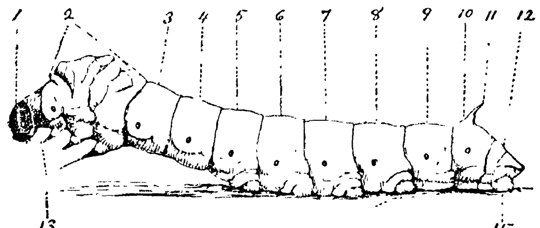


Fig. 647. Full-grown silkworm: 1, head, 2, thorax, 3-10, 12, abdominal segments, 11, horn; 13, true legs, 14, pro-legs, 15, anal pro-legs.

South Carolina and Georgia engaged in the industry to a certain degree. Some reeling was done on hand-reels, and both cocoons and reeled silk were sent to Europe. In 1759, Georgia produced 10,000 pounds of cocoons, and, reeled in the colony on hand-reels, the resulting silk commanded a higher price in the London market than that from the old silk-producing countries. The culture was introduced into New England about 1660, in parts of Connecticut and also on Long Island. Pennsylvania and New Jersey started the industry in 1771, but all work in the northern states was interrupted by the Revolutionary war. In 1828, an attempt was made to revive the industry and a treatise on the raising of silkworms was published by order of the national Congress, which was followed by a determined effort to establish the culture on a firm basis. In 1833, it was estimated that four tons of cocoons were produced in the county of Windham, Conn. The interest in the industry soon passed beyond bounds, and what was known as the "*Morus multicaulis* craze" originated. Thousands of individuals purchased mulberry cuttings and planted many acres of valuable land; investments far exceeded possible returns; heavy freezes destroyed the plantations, and, in the course of a few years, the many failures caused so complete a revulsion of feeling that not only was silk-culture practically abandoned in the United States, but the very name became a byword.

Since the bursting of the multicaulis bubble, sporadic attempts to revive the industry have been started in California, Utah, Louisiana, Alabama and Georgia. Moreover, in 1884, Congress began making appropriations for the encouragement of silk-culture in the United States, under the United States Department of Agriculture. These appropriations were continued until 1890 and then lapsed. During the progress of this work, under the Department of Agriculture, mulberry trees and eggs of the silkworm moth were sent to correspondents throughout the country, a manual of instructions was published and distributed, and silk reels were operated in New Orleans and in Washington. The work ceased June 30, 1891.

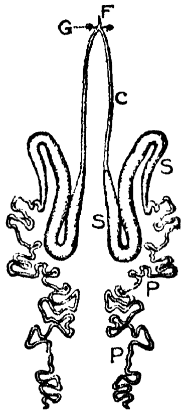


Fig. 648. Silk glands of a mature worm: P, part of glands that secretes the silky matter; S, reservoir; C, conducting canal; F, spinneret; G, accessory glands. (Redrawn from Verson and Quajat.)

The national work, under the Department of Agriculture, was resumed in July, 1902. The Secretary of Agriculture, Hon. James Wilson, had come to the conclusion that every possible effort should be made to ameliorate the condition of the extremely poor people of the southern states, and particularly of the colored race. Among the many ideas that suggested themselves to him was that of silk-culture, which, as a household industry, adds to the wealth and prosperity of other countries and to the family incomes of the extremely poor. Congress made a special appropriation, and the work has been continued up to the present time. Silk reels have been imported from Europe; operators were also imported as teachers, and American girls have been shown the process of reeling cocoons. Well-tested disease-free eggs have been imported from Europe, and mulberry seed of desirable varieties has also been brought over. Experimental nurseries have been started; experimental rearings have been made; eggs have been sent to all applicants who could guarantee a supply of food for the worms, and mulberry cuttings have been sent to those not similarly situated. The cocoons raised by the correspondents of the Department have been purchased at the European market price, and have been reeled at the reeling establishment in Washington. The resulting raw silk has proved to be of good and salable quality.

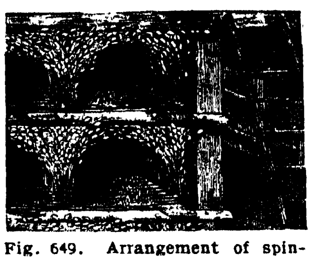


Fig. 649. Arrangement of spinning places. (Redrawn from Pasteur.)

So long as Congress continues its support, there is, therefore, at least a temporary market for cocoons in America. The profit to raisers is extremely small, but a large number of correspondents throughout the country have considered it worth while to continue the culture, and eventually it is hoped by the Department that a more natural market for cocoons will be established. The prerequisite for such a market, however, is a guaranteed crop of cocoons, and it is to establish a good supply of mulberry trees in different parts of the country and a large number of skilled silkworm-raisers that the efforts of the Department are devoted.

It has been very difficult to prevent false hopes from being aroused. In spite of the greatest care in the wording of circulars and other publications and of correspondence, very many persons have taken up silk-culture in the hope of being able to make a living exclusively from this industry. Pathetic letters have been received by the writer and others from widows who hoped to support dependent families in this way, and other individuals have expected to become wealthy in a short time by the raising of silk. Such persons have soon abandoned the attempt, but there remains a fairly good number of well-trained silk-culturists in America as a result of the efforts of the Department of Agriculture.

Limitations of the industry.

In considering the raising of silkworms as an agricultural industry, it must be noted that the countries where it has been most successful are the countries where labor is cheapest. The profits from the raising of worms are nowhere large, and, owing to various conditions, can never be large. It has been shown to be practically impossible to raise cocoons on a large scale in a single establishment. At all events, experimental work in this direction has almost invariably failed. The silkworm thrives best in small cultures, and for that reason in silk-raising countries the industry has become a household industry. A given family of peasants — nearly always agriculturists — will raise a certain number of worms annually, and the money resulting from the sale of the cocoons furnishes only a part of the annual income of the household. In other words, it is a side industry, as is the household raising of bees and chickens in other countries.

Then too, the successful operation of an establishment for the reeling of cocoons with the reeling machines devised up to a comparatively recent date has also depended to a very large extent on cheap labor. There is a prospect that this difficulty may be overcome to a certain degree by the operation of a machine recently invented and introduced into Italy, whereby the earning capacities of the machine itself are very greatly improved. But, even with improved machinery, the country where labor is cheapest will always be able to produce the cheapest raw silk.

In the United States, therefore, as in other countries, silk-culture must always be a household industry of little profit, and therefore one to be undertaken largely by those who have no other means of occupation, such as the non-productive members of a large family, simply as a help toward the paying of the expenses of the family.

Possibilities of the industry.

Conditions in China, India, Persia, and other Asiatic countries, including Syria, are not to be compared with those in South European countries, or scarcely even with those in Japan, and it is with Italy and France that the possibilities of silk-culture in the United States must be compared.

France has long been able to raise excellent cocoons, and as a manufacturer of silk goods she is a steady rival of the United States, even when we consider that the manufacture of silk in America is aided greatly by the protective tariff, and assisted further by the absence of an import duty on raw silk. But France has been unable of late years profitably to operate large reeling establishments without government aid, and this aid has been furnished in the nature of a government subsidy of a certain number of francs annually per basin operated in all of the filatures of France. In Italy, there is no such governmental subvention,—the reeling establishments stand on their own bases,—and therefore Italy, with its varying climate, with the scientific and practical qualifications of its people and its intelligent peasantry, affords the best example of what can be done with silk-culture as an agricultural industry among a civilized modern race.

A concrete example of what silk-culture means to a poor family of Italian agriculturists may be cited, perhaps, as an average example. The writer studied the cocoon harvest in northern Italy in the summer of 1905. Owing to a rather small crop throughout the kingdom, the price was somewhat higher than normal, reaching 3.68 lire, or 71 cents per kilogram of 2.205 pounds of green cocoons. The question of compensation of families for cocoons reared was observed. The best result noted was in the case of one small, hard-working family consisting of a husband and wife, a half-grown boy and two little girls. This family brought in 87.40 kilograms, or 192⅔ pounds, for which they were paid 321.63 lire, or about sixty-two dollars. The average amount earned per family on the large estate where observations were made was twenty-five to thirty dollars, a very welcome addition to the income of a hard-working peasant family.

Supposing the eventual establishment of commercially paying filatures in America, on a scale commensurate with those of Italy, the example cited will serve as an illustration of what may be expected of the raising of silkworms as an agricultural industry in this country. The question of the establishment of such commercial filatures, however, is one that has not yet been solved. Could America produce her own raw silk, the money saving to the nation could be approximately estimated from the following table of the importations of raw silk during the years 1898 to 1902:

IMPORTATION OF RAW SILK (AS REELED FROM THE COCOON), 1898–1902

Countries from which imported	1898	1899	1900	1901	1902
France	$1,192,058	$1,248,037	$1,607,569	$1,220,874	$1,866,202
Germany	. . . . . .	1,101	19,480	2,386	29,106
Italy	6,227,004	8,929,776	10,816,084	7,151,438	9,954,501
Switzerland	9,194	4,133	40,950	681	17,422
Turkey in Europe	. . . . . .	. . . . . .	. . . . . .	. . . . . .	38
United Kingdom	1,752	956	7,301	9,763	1,421
Dominion of Canada	56,468	18,296	157,161	60,109	807,706
Chinese Empire	7,506,409	6,497,983	12,171,309	6,303,523	8,308,383
East Indies—British	389	476	24,659	33,456	27,190
Hongkong	120	205,516	17,027	. . . . . .	. . . . . .
Japan	16,453,406	14,920,787	19,686,132	14,571,547	20,702,101
Turkey in Asia	. . . . . .	. . . . . .	. .	. . . . . .	261
Total	$31,446,800	$31,827,061	$44,549,672	$29,353,777	$41,714,331

Literature.

Enrico Verson, Il filugello e l'arte sericola, Trattato teorico-pratico, Padova, Verona (1896), Giovanne Bolle, Der seidenbau in Japan, Budapest (1898); Henrietta Aiken Kelly, The Culture of the Mulberry Silkworm, Bulletin No. 39, new series, Division of Entomology, United States Department of Agriculture (1903); Henrietta Aiken Kelly, Silkworm Culture, Farmers' Bulletin No. 165, United States Department of Agriculture (1903); George W. Oliver, Silkworm Food Plants, Bulletin No. 34, Bureau of Plant Industry, United States Department of Agriculture (1903); L. O. Howard, The United States Department of Agriculture and Silk Culture, Yearbook of United States Department of Agriculture for 1903; H. L. Alphonse Blanchon, Manuel pratique du sériculteur, Paris (1905); Pierre Vieil, Sériciculture, Paris (1905); Maillot & Lambert, Traité sur le ver à soie, Paris (1906).

SPONGES. *Porifera.*

By *Julius Nelson.*

The sponge fishery in the United States began in 1852. It is confined to Florida, particularly in the region of the coral "Keys." The most valuable form commercially, is the sheepswool (*Spongia gossipina*), which brings two to five dollars a pound. The yellow sponge and grass sponge, of stiffer texture, bring only twenty-five to fifty cents a pound. The Florida sponge industry employs 2,245 persons, on 156 vessels, which, with other apparatus, are worth nearly $600,000. The annual catch was valued at about $400,000 in 1904. Key West and Tarpin Springs are the main centers of the sponge trade.

The sponge, as seen on the market, is only the horny, fibrous skeleton, which in nature is clothed with cells (flesh). The pores and channels seen in the skeleton are present also in the living animal. Water laden with microscopic organisms is drawn in through the small pores, and emitted by the larger channels, being propelled by cilia that clothe numerous small chambers, which are interposed between the inhalent and exhalent channels.

Sponges reproduce by fertilized eggs, scattered through the flesh. The young develop into ciliated larvæ, and are discharged by the exhalent channels. They very soon settle and become attached to the bottom; and, in case of the wool sponge, they grow to be a weight of one-tenth of a pound in six months, attaining a minimum marketable size within a year.

Sponge-fishing.

The sponges are observed from the small boats by means of a water-glass. This is a box or bucket with a glass bottom, placed on the surface of the sea. The sponges are torn loose by means of a pole armed with long, hook-like teeth, or by means of tongs, not unlike oyster tongs. Placed on the deck, they soon die of suffocation and undergo decay. After a few days, when the larger boat has become loaded, it proceeds to the "kraals," which are pens made of saplings, and having interspaces small enough to prevent the sponges floating out, while permitting free circulation of water. Thus, the decayed flesh is macerated away, and then the sponges are washed and beaten to clean them, and finally are dried in the sun. This is known as natural bleaching. The very white sponges on the market have been bleached by means of acids and alkalies, which greatly weaken the fiber. Washing in soapsuds also bleaches, but without weakening the fiber.

Artificial propagation.

Professor Wilson, of the University of North Carolina, ascertained the feasibility of raising sponges from the egg. It is necessary in July and August to transfer the sponges to tubs of sea-water, without exposing them to the atmosphere. Then the embryos will be prematurely discharged through the stimulus of the unnatural environment, and they can be transferred to live boxes of cloth floated in the sea, where they will fasten and start growth. Professor Wilson also found that when sponges in aquaria or tubs undergo partial decay and degeneration, along the canals, on the surface and about the central chambers are formed clusters of cells that revert to a plasmodial condition. Each

such cluster is capable of reproducing the sponge, similar to the natural "gemmules" of the fresh water *spongilla*.

Quicker results in propagation are secured by means of cuttings and grafts. Successful experiments in raising sponges from cuttings were conducted in 1903, by J. Percy Moore, under the direction of the United States Fish Commission. This method is, commercially, more practicable than are the other methods.

Literature.

Bulletins of United States Fish Commission: 1897, p. 241; 1899, p. 149; 1900, Vol. 2, p. 375; 1902, p. 161; Science, Vol. XXV, p. 912.

SWINE. *Sus scrofa*, Linn. *Suidæ*. Figs. 55–57, 290, 650–679.

In North America the hog has undergone a special development, due in part to the existence of abundance of maize and in part to the desire of the people for fat pork. The English hog is likely to be large-boned, long-bodied, flat-sided and rangy. The American hog, in its typical development, is small-boned, short, cylindrical and compact in body, with short legs and flat or broad back, and it is capable of maturing early and laying on an enormous load of fat. The American hog is less a question of breed than of feeding and management. The Poland-China is an American breed, however, embodying the American ideas of a well-shaped fat-producing or lard hog. There are several other American breeds, as described in the subsequent pages. The Canadians have given much attention to bacon-producing hogs, but swine-raisers in the United states have given comparatively little consideration to this type. [For a comparison of the two types, see the score-card discussion on pages 54, 55.]

Throughout the corn-belt, the fat or lard hog attains the greatest perfection, and there it is bred in enormous numbers. The practice has developed of producing hogs to "follow the cattle," which is to turn hogs in with cattle that are being fed for beef in order that they may secure the wasted and voided grain. Wherever beef animals are corn-fed, therefore, hogs have come to be natural accompaniments.

Much has been said about the relation of breed to economy of meat-production, and it may be well to examine the subject. Probably the most extensive experiments with breeds of swine have been conducted by the Ontario Agricultural College and the Iowa Agricultural Experiment Station. At the Ontario Agricultural College, five experiments were conducted in which six breeds of swine were compared as to the cost of producing 100 pounds of gain in live weight. The average amount of meal consumed for 100 pounds of gain, live weight, in the five experiments is given in the table, only the meal being considered. Such foods as dairy by-products and green feed, which were fed sometimes, were the same for all breeds, and have been omitted to simplify the comparison:

Meal Consumed for One Hundred Pounds Gain, Live Weight

(Average of five experiments)

Berkshire	364.45 pounds
Yorkshire	369.51 pounds
Tamworth	380.47 pounds
Duroc-Jersey	384.23 pounds
Chester-White	387.89 pounds
Poland-China	391.42 pounds

Averages, however, are frequently misleading. For example, in a certain experiment one breed may suffer from some unfavorable circumstance which is in no way related to, or influenced by, the breeding of the animals, yet this circumstance may seriously affect the records of the breed in question. It is much more satisfactory, therefore, to examine each experiment individually, and see whether there is any constancy in the standing of the breeds. The table given below shows the breeds ranked in order of economy of gain for each experiment:

Ontario Experiments

Breeds arranged in order of economy of production.

First experiment	Second experiment	Third experiment
1. Berkshire	1. Berkshire	1. Yorkshire
2. Tamworth	2. Tamworth	2. Berkshire
3. Poland-China	3. Poland-China	3. Duroc-Jersey
4. Duroc-Jersey	4. Chester-White	4. { Tamworth Chester-White
5. Chester-White	5. Yorkshire	
6. Yorkshire	6. Duroc-Jersey	6. Poland-China

Fourth experiment	Fifth experiment
1. Berkshire	1. Berkshire
2. Tamworth	2. Yorkshire
3. Yorkshire	3. Duroc-Jersey
4. Chester-White	4. Chester-White
5. Duroc-Jersey	5. Tamworth
6. Poland-China	6. Poland-China

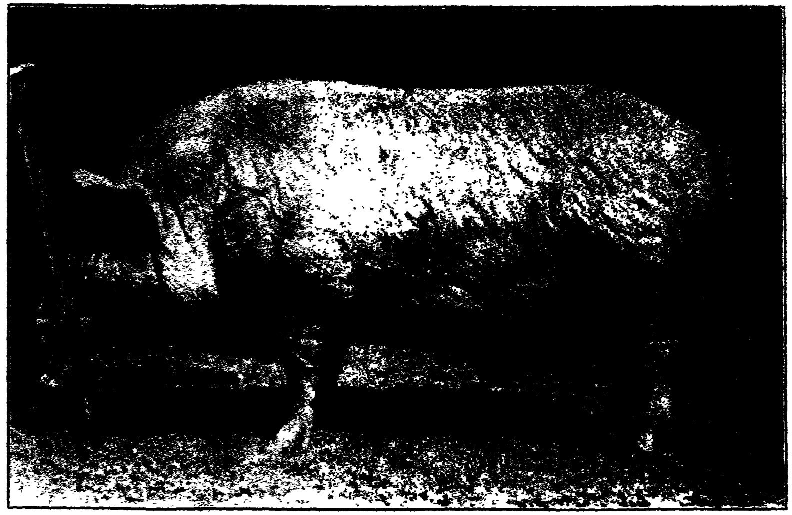
Before any comment is made on these results, it will be better to examine the Iowa experiments, where three tests were made with the same six breeds.

Iowa Experiments

Breeds arranged in order of economy of production.

First experiment	Second experiment	Third experiment
1. Duroc-Jersey	1. Duroc-Jersey	1. Yorkshire
2. Yorkshire	2. Yorkshire	2. Poland-China
3. Tamworth	3. Berkshire	3. Berkshire
4. Poland-China	4. Poland-China	4. Duroc-Jersey
5. Chester-White	5. Chester-White	5. Chester-White
6. Berkshire	6. Tamworth	6. Tamworth

Middle White sow



Victoria boar

Small White boar

Large White boar

Plate XXIV. Breeds of white hogs

The results of these eight experiments make an interesting contribution. A careful study of the case can result in but one conclusion,—that economy of production is not a question of breed, but is a matter of individuality. The hog that has constitution and quality will make economical use of the food it consumes, no matter to what breed it belongs.

To illustrate the fallacy of judging the relative merits of different breeds as feeders, from the results of experiments with breeds, attention may be called to the fact that, if a man based his judgment of the breeds on the results of the Ontario experiments, he would arrive at an entirely different conclusion from the man who drew his conclusions from the Iowa experiments; and the man who averaged the Ontario and the Iowa results would make a still different arrangement of the breeds. Or, if another person judged the relative feeding qualities of Yorkshires, Tamworths and Poland-Chinas from the average results of Shaw's two experiments with these breeds in Minnesota, he would reverse the standing of the Tamworths and Poland-Chinas as given in the Iowa experiments. It may be possible that some breeds contain more animals of high merit as feeders than do others, but experimental work has not yet demonstrated which breeds these are. A breed that might be best in one place or under one set of conditions, might not be so good under other conditions. Therefore, so far as experiments go, it has never been demonstrated that any one breed excels all others in point of economical use of food. Breed experiments have demonstrated that hogs of bacon type are capable of making as cheap gains as hogs of the fat or lard type. This fact has been a surprise, since it is contrary to established beliefs and prejudices; but it stands out more prominently than any other point in the comparisons that have been made. The best hog-raiser is the one who most critically chooses a breed as a starting-point, and then feeds and manages a drove most consistently.

The Yearbook of the United States Department of Agriculture for 1906, gives the number and farm-value of swine in the United States and in the seven leading states (all with a farm-value above $20,000,000), on January 1, 1907, as follows:

	Number	Farm value
United States	54,794,439	$417,791,321
Iowa	8,584,500	81,552,750
Illinois	4,449,705	37,377,522
Nebraska	4,080,000	35,496,000
Missouri	3,454 950	24,530,145
Indiana	2,924,879	23,399,032
Kansas	2,561,200	21,001,840
Ohio	2,436,797	20,103,575

The same yearbook gives the number exported for the year ended June 30, 1867, as 3,577, with a value of $40,092; for the year ended June 30, 1906, 59,170, with a value of $630,998.

Again, the number of swine in Canada is given in the same yearbook as follows:

Canada		2,875,692
New Brunswick	1905	55,000
Ontario	1906	1,819,778
Manitoba	1906	200,509
Saskatchewan	1906	123,916
Alberta	1906	114,623
Other	1901	561,866

The Canada Yearbook for 1905, gives the number of swine killed or sold in 1901, as 2,555,413. It gives the value of swine in Canada, for the same year, as $16,445,702, and the total number as 17,922,658.

In regard to the exports of hog products, the 1906 Yearbook of the United States Department of Agriculture, gives the following figures:

	1902		1906	
	Quantity, pounds	Value	Quantity, pounds	Value
Lard	556,840,222	$52,375,864	741,516,886	$60,132,091
Lard compounds	36,201,744	2,687,653	67,621,310	4,154,183
Pork				
Fresh	44,171,674	3,652,464	13,444,438	1,261,412
Cured				
Bacon	383,150,624	35,449,797	361,210,563	35,845,793
Hams	227,653,232	25,222,744	194,267,949	20,075,511
Salted or pickled	115,896,275	10,117,562	141,820,720	11,681,634
Total cured	726,700,131	70,790,103	697,299,232	67,602,938
Canned	9,603,882	832,910	12,699,800	1,215,857
Total pork	780,475,687	75,275,477	723,443,470	70,080,207
Sausage and sausage meat	7,137,297	726,437	7,926,786	881,686

These various figures seem to confirm the general American experience to the effect that the emphasis on feeding, to which so much attention is given, is not misplaced. It is not wise for the hog-raiser to ignore breeds, but he must not depend wholly on the breed for the production of desired results.

Further statistics may be found in the Twelfth Census Reports, but these animals breed so rapidly and are likely to fluctuate so much that figures eight or nine years old may not express the present facts. The Canada Yearbook for 1905, gives the following figures on exports of hog products:

	1902	1905
Bacon	$12,162,953	$12,194,458
Hams	240,840	321,501
Pork	54,070	188,194
Lard	22,186	110,540

Literature.

The following books may be consulted for additional information on swine: F. D. Cobourn, Swine Husbandry, New York (1888); John Coleman, Cattle, Sheep and Pigs of Great Britain, London (1887); John A. Craig, Judging Live-Stock, College Station, Texas (1904); George W. Curtis, Horses, Cattle, Sheep and Swine, College Station, Texas (1888); George E. Day, Swine, Agricultural College, Guelph, Canada (1905); Joseph Harris, Harris on the Pig, New York (1870); James Long, The Book of the Pig, London; David Low, On the Domesticated Animals of the British Islands, London (1842); Charles S. Plumb, Types an Breeds of Farm Animals, College of Agriculture, Columbus, Ohio (1906); J. H. Sanders, The Breeds of Live Stock, Chicago (1887); Thomas Shaw, The Study of Breeds in America, New York (1900); S. M. Shepard, The Hog in America, Indianapolis (1896); Samuel Sidney, The Pig, London (1871); Sanders Spencer, Pigs: Breeds and Management, London (1897); Robert Wallace, Farm Live-Stock of Great Britain, Edinburgh (1907); Various Writers, The Best Breeds of British Stock, London (1898); William Youatt, and W. C. L. Martin, The Hog, New York (1863); F. D. Coburn, Swine in America.

INDEX TO SWINE ARTICLES

Origin of Domestic Swine. Figs. 650–652.

Swine belong to the natural family *Suidæ*, mostly of tropical countries, which is represented by several genera, of which the chief is *Sus*. The exact zoölogical origin of the domestic hog is not clearly made out. It is generally considered to have descended from the wild boar, *Sus scrofa* (Fig. 650), of Europe, North Africa and Asia. It is likely, however, that an Indian species (probably *Sus cristatus* or *S. Indicus*) has entered into the evolution of the domestic forms.

Hog-like animals of other genera inhabit many parts of the world, as the babirussa of East India (Fig. 651), the little peccaries (Fig. 652) of South America (ranging also as far North as southern Arizona and Texas) and the only close relatives of swine indigenous to the American continent, the warthog of South Africa. None of these swine-like animals appear to have been domesticated, although tamability and fecundity in confinement seem to be characteristic of most of the group.

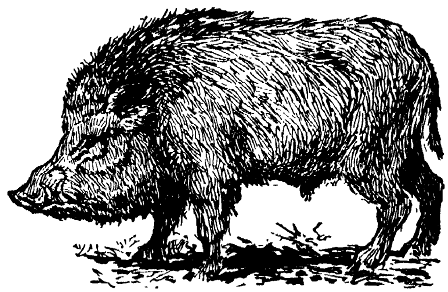


Fig. 650. Wild boar (*Sus scrofa*).

The hog seems to have come into domestication in the Orient, but the animal is now widespread, with many variations that adapt it readily to very various conditions. It tends to run wild in mild climates, as exhibited in the razorbacks of our southern states. Although very widely domesticated from earliest times, the hog is not eaten by some important races or religions of people, as the Jews, Egyptians and Mohammedans. The hog yields hides that produce very tough and resistant leather, but it is grown only for its flesh, in this respect differing from all other domestic animals.

The wild boar (*Sus scrofa*) still exists in central and southern Europe and in Asia; it is extinct in Great Britain. From the earliest times it has been a much-sought game animal, the boar hunt being one of the leading diversions of royalty and nobility. It is a fierce and swift animal, larger than the domestic swine. It sometimes stands over three feet high, and will weigh 250 pounds, which is heavy weight for a swine-like animal that is not fat. The wild boar is grayish black or iron-gray or brownish, when mature, but spotted and striped when young. The male becomes shaggy, with a heavy crest or mane along the forward part. When young, the male follows the sow and the litter, but after three or four years roams alone, developing in ferocity, and attacking dogs and men when pursued. The great tusks are formidable weapons. The boar inhabits mostly low forests, where it roots up the ground in furrows.

Domestication has greatly modified the hog. It has become docile, although old boars may be vicious when aroused. The most marked development has been in the great ability to lay on flesh. So far has this gone, that, in some cases, the legs will barely support the animal and it is practically incapable of locomotion to any extent. The head and snout have become refined and modified and

changed in shape; the color varies from white to brown-red and black; the size from 150 pounds to as much as 900 pounds when mature and fat. Hogs are now slaughtered before they have reached full age, and the demand has changed somewhat from fat pork to lean bacon and hams.

The hog is a non-perspiring animal (in the sense in which horses and men perspire). It wallows in water and mud to keep itself cool. In the hot mid-continental hog regions it is generally considered that wallows for hogs are necessary, but in other regions they need not be provided, particularly if groves or woods are accessible. The hog is usually considered to be a dirty or unclean animal in its habits, but this habit is due mostly to the way in which the animals are kept. Hogs would be clean if given an opportunity. The modern hoghouse plans for thoroughly cleanly and sanitary quarters (Vol. 1, p. 260).

The male of the swine is known as a boar; the female, as a sow. A young pig, particularly after weaning, is a shoat or shote; a castrated animal is a barrow. A young sow is sometimes known as a gilt. In North America, the common generic term for all these animals is *hog*; in England *pig* seems to be preferred. In America, *pig* is generally used for a young hog.

Swine are variously classified, according to color, size or utility. The classification by color has not been popular, but either of the other two may be said to be accepted. A classification based on utility—the production of lard or bacon—would seem to be the more rational; but even this classification is unsatisfactory, as some breeds are useful for both purposes. On this utility basis we have the American fat- or lard-hog type, embracing the Berkshire, Chester-White, Cheshire, Duroc-Jersey, Essex, Poland-China, Small Yorkshire, Suffolk and Victoria; and the bacon type, embracing the Large Yorkshire and Tamworth. If we classify the breeds according to size, we would have: (1) Large breeds: Chester-White,

Fig. 651. The Babirussa (*Babirussa alfurus*). **Adapted** from Brehm.

Large Yorkshire, Tamworth. (2) Medium breeds: Berkshire, Cheshire, Duroc-Jersey, Hampshire, Poland-China, Victoria. (3) Small breeds: Essex, Small Yorkshire, Suffolk.

Literature.

For references, see page 646.

Lard- and Bacon-production.

By *M. W. Harper.*

Of late years, pork-production has become somewhat diversified, and, as a result, we have two kinds of hogs, the lard hog and the bacon hog, the former noted for its natural heavy fat-production, the latter for its liberal admixture of lean with fat. In general appearance, the lard hog should be

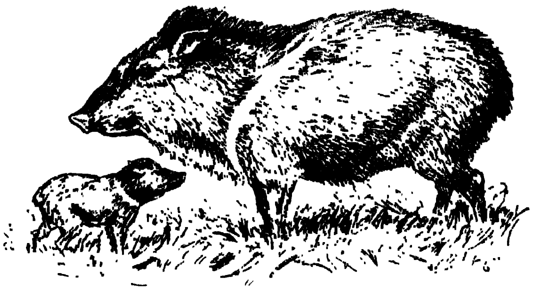


Fig. 652. The Collared peccary (*Dicotyles torquatus*). **Three** species are native in South America.

compact, with a thick, deep body, short head, broad back, strong hams, short legs, and plenty of quality as shown in abundance and fineness of hair, strong bone and joints. The temperament should be mild, yet active, for the disposition has much to do with determining whether the animal is a desirable breeder or feeder. Size and weight have a bearing on the market price for pigs of this type, and at the present time the average weight of pigs sold on the market ranges about two hundred and twenty-five pounds. With the bacon hog, the back is not so broad, the sides are longer, the shoulder smoother, the ham lighter and the leg somewhat longer. The general flesh covering is much less fat than with the lard type. The weight of the bacon hog most acceptable in the market is 180 to 190 pounds live weight, although 200 pounds is not excessive. The larger hog is not approved in the bacon-producing sections of this country, the smaller being preferred. Denmark, Ireland and Canada furnish much of the bacon of today. In describing the type most desired, the Ingersoll Packing Company of Canada says that the packer calls for the long, lean pig, as it is the one that suits best. It is the most difficult to procure, but is the only kind that will furnish the desired "Wiltshire sides;" and it will also make any of the other cuts the market calls for. [See page 54, 55.]

Factors in lard- and bacon-production.

The differences in type have been brought about in part by climatic conditions, which control the kind of food with which the pork has been produced, and in part by market requirements. Throughout the dairy districts of northeastern United States and in Canada, the bacon type can be produced at a handsome profit, due in part to the fact that bacon-producing foods can be grown more cheaply than lard-producing foods, and in part to the fact that there is a better market for the bacon type than for the lard type. This is

especially true of Canadian bacon, which is exported to England in large quantities. The question of a better market is very important, for hogs fed to produce a large percentage of lean meat, to be profitable, must sell for at least ten per cent more than the current prices. The eastern and the English markets, which are very discriminating, recognize this and pay the difference for a good product. On the other hand, throughout the corn-belt we have every condition favorable to the production of the lard hog. As long as corn can be produced as cheaply, compared with other crops, as at present, it must remain the great pork-producing food. Corn makes pork of fine quality and great firmness if properly fed. Since it is a highly carbonaceous food, it must be supplemented with some food rich in protein if the best results are to be obtained. It is against the abuse of corn and not the use of corn, that we should contend, for if pork-production is to continue one of the leading industries, a large part of the product must continue to be the result of feeding corn. Since corn is the great fat- or lard-producer, we have the lard-belt almost co-extensive with the corn-belt. It is well to bear in mind, also, that many packers in the West pay more for the fat or lard hog than for the bacon hog. This is not because they expect higher prices for lard, but because a high price for salt pork is paid for that which is thick, heavy and nearly free from lean meat.

Among the qualities necessary for first-class bacon, none is of greater importance than firmness. A tendency to softness or tenderness is quite sufficient to rate bacon at second-class prices, and if this softness is at all pronounced, to make it altogether unsalable at a profit.

Before we can discuss intelligently the production of "firm" and "soft" bacon or pork, it is necessary to ascertain the difference in composition between them. We find that the fats of meat are made up essentially of olein,—a fluid fat at ordinary temperatures,- and palmatin and stearin,—solid fats at ordinary temperatures. Hence, we conjecture that the percentage of olein would be greater in the fat of soft than of firm pork. The Central Experimental Farm of Canada made some experiments to determine this matter, and found such to be the case—the soft fat containing a relatively higher percentage of olein and the firm fat a relatively higher percentage of palmatin and stearin. These experiments indicate that not only is there a close relationship between the consistency of a fat and its composition, but also that the food has a marked effect on the composition and hence on the consistency or relative firmness. The oil of certain foods possesses more of the fluid fats, while the oil of other foods possesses more of the solid fats, which find their way in part through the animal economy into the body fats. Again, the fat of very young pigs, of pigs that have made a rapid growth, and of pigs that have made an unhealthy growth, is softer than of finished pigs that have increased steadily in weight. As yet no exact standard of firmness has been established; that is, it cannot be said exactly what percentage of olein is to be considered as the limit for pork that may be said to be firm.

Market rating of American bacon.

Since our lard pork has a world-wide market, it need receive no comment here; but since most of the bacon finds its way to England, it might be well to point out some of the peculiarities of the English market. England is the great bacon market, and procures most of this product from Denmark, Ireland, Canada and the United States. One fact worthy of consideration is that of these four countries, the bacon from the United States sells for less per pound than that from the other three countries. During the seventeen years for which we have figures regarding Danish bacon, the valuation per hundred pounds has been less than eleven dollars in only three years. In the years 1893 and 1901, it was more than thirteen dollars. On the other hand, during the same period, in only three years has the bacon from the United States had a valuation of more than nine dollars per hundred pounds. In no year has it sold up to the average valuation per hundred pounds for the total imports of bacon to the United Kingdom.

There are, perhaps, three general causes of this condition. First, as these figures would seem to indicate, the Danish bacon is no doubt a finer product than that produced in the United States. Second, there is a more constant demand for the Danish bacon in the English markets. Third, because the Danes do furnish regularly the better bacon, they supply the finer trade. It is evident that the English people buy American bacon because it is in abundance and cheap in price, and they pay for it only when forced to do so by the small amount and the high price of the Danish bacon.

An example.

The methods of producing Danish bacon may be of interest. Mr. J. H. Ginge, manager of the Canadian Packing Company, of London, Ontario, and others who have made a study of Danish methods, report that the Danish farmers select long, lean sows from the best mothers, more especially of white color. Pork-packing corporations bring in the right sort of boars, which are often of the Middle or Large English Yorkshire breed, as these produce the best English bacon. The finest Danish bacon is made by feeding the right sort of pigs on barley and rye, with boiled potatoes, raw turnips cut fine, skimmed milk, buttermilk and grass in summer and roots in winter. The young pigs are allowed to run about and grow without putting on much fat from the time they are weaned till within six or eight weeks of the time they are to go to market. A finished Danish bacon pig ranges from 180 to 225 pounds in weight. It is a long, lean hog with plump, well-developed hams, thick, straight belly, and fat on back not exceeding one and one-half inches in thickness. The Danish hog is raised largely on dairy-farms, but many small lots are raised and fed by peasants or laboring men. As a rule, the grain fed is ground and

soaked over night, mixed with other foods and given to the hogs when on the point of turning sour. The hogs are never fed more than is eaten up clean at each meal.

Literature.

For references, see page 646.

The Feeding of Swine. Figs. 653–657.

By *W. J. Kennedy, Wayne Dinsmore* and *J. A. McLean.*

The question of swine-feeding engages the attention of persons in practically all parts of the civilized world. In some places farmers engage in the industry as a specialty; in others, only enough pigs are reared to utilize the wastes of the farm; while in the American corn-belt the hog is used to utilize that part of the grain ration which escapes the digestive organs of the cattle. In many countries in which dairy-farming is followed as the chief occupation, pigs are reared and fed in considerable numbers as an auxiliary industry. While several different methods of feeding and management are pursued with good results, certain principles in common are recognized as forming the basis of the work. These will be treated under four different heads or divisions, namely: the breeding boar, the breeding sow and young pigs, finishing the lard or fat hog, and finishing the bacon hog.

The breeding boar.

The food of the boar should be varied somewhat in accordance with his age and the season of the year. Young boars should be fed more concentrated food than should mature animals. During the breeding season, the boar should be fed more liberally and on a more nutritious ration than during that part of the year when not used for service. At all times the food of the boar should be varied, of a nutritious nature, and, in the case of grown animals, moderately bulky. It is especially important that some form of succulent food be supplied throughout the entire year. Where grass

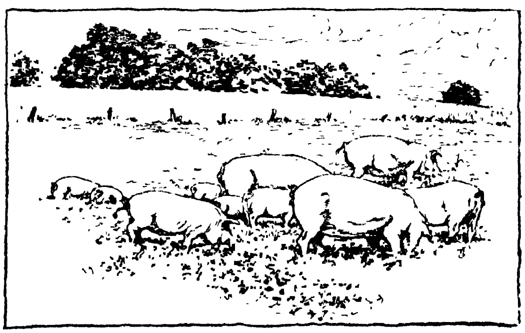


Fig. 653. Pig-feeding scene in middle West.

is not available, such foods as roots or finely cut clover or alfalfa leaves during the winter, and green food of some kind during the summer, should always be fed in addition to the grain ration. The grain ration should be composed of foods rather rich in protein and of a cooling nature, as foods rich in carbonaceous matter tend to produce obesity and a heated condition of the digestive organs,

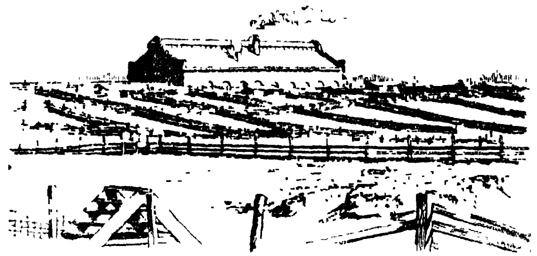


Fig. 654. Colony houses and pens in the West.

both of which are detrimental to any sires, oftentimes causing sterility

Of the various kinds of grain, finely ground oats are perhaps the most desirable for the bulk of the ration. The addition of wheat middlings in the case of a young boar, or wheat bran in the case of a mature animal, to the extent of one-third to one-half of the ration by weight, added to the oats, makes a most useful combination. Skimmed milk may be fed to good advantage, especially to young boars. For the purpose of furnishing bulk, variety and succulence during the winter months, some second-crop clover or alfalfa hay, cut up finely, soaked in warm water and mixed with the grain ration, gives excellent results. The boar should not be overfed, but given just what he will eat up clean. By all means, the feeder should avoid having the boar fat, as it is just as injurious as to have him too thin. Regular exercise should be given throughout the entire year. This can usually be furnished through the medium of a grass lot in the summer and a small yard adjoining the pen during the winter months.

The feeding and management of breeding sows and young pigs.

Breeding sows are kept for their present or prospective value as pig-producers. Their management and feeding is purely a business proposition. Irregular breeders, sows that produce but few pigs at birth, or sows whose pigs are not of high excellence as individuals, should be weeded out as soon as possible. Sows that are not in themselves good representatives of the type sought, and that are not descended from prolific ancestry, should not be taken into the herd as breeding sows.

In the practical management of sows, or sows and pigs, health is of primary importance. Sunlight should have access to all parts of the hog sheds or shelters. With sunshine, good ventilation and thorough cleanliness must be provided. All sleeping quarters, feeding floors, troughs and shelters frequented by the pigs should be disinfected once a month with some good disinfectant. The coal tar or other good disinfectants should be used freely by means of a good barrel spray-pump. Careful study will enable any intelligent owner or herdsman to keep his herd in a healthy condition,

and every hog-raiser should keep in touch with sources of information, such as the agricultural experiment stations and the national department of agriculture.

In feeding breeding sows, the aim should be to supply the nutrients needed for maintenance or growth, and such additional food nutrients as may be required for the pigs in utero or nursing, as the case may be. Good pasture (blue-grass, clover or alfalfa) is the cheapest feed, and furnishes the elements most needed to build a strong, bony framework and a well-developed muscular system. In the southern states, cowpea and soybean pasture fill the place that is occupied by clover in the central states and by alfalfa in the central-western and far western states. In most of the northern states, clover or alfalfa can be grown, and where these are not regularly grown the Canadian field-pea fills the same place, and, with blue-grass,—often known as June-grass—must form the chief pasture feed. The sows should have access to pasture for as much of the time as weather conditions will permit. In practically all localities south of the forty-second parallel of latitude, they can be permitted to range at will on winter pastures, except during the stormiest days of winter, which are few.

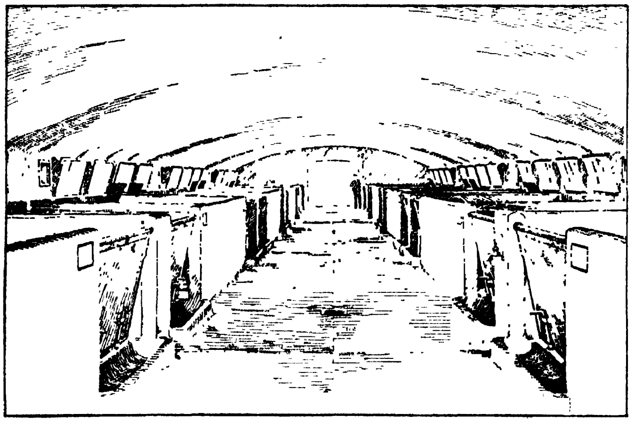


Fig. 655. Concrete hoghouse.

If sows are to produce but one litter per year, this should come about the first of March; when two litters are to be produced, the second litter should come early in September. Sows should be in fair flesh and gaining well about the time they are to be bred, for conception is then more certain. The period of pregnancy is 112 to 116 days. This makes it possible to have the sows on pasture (in all districts south of the forty-second parallel) during both periods when they are to be bred.

In feeding sows that are to produce but one litter per year, one must see to it that their pigs are weaned by the first of August. Young sows that have never produced pigs should receive, from the time they are weaned until they are of age to breed, about one-half ration of grain; and the mixtures recommended later for young growing pigs are the right ones for these young sows on pasture. Mature sows need nothing except good pasture during August and September. In October, some corn—about two pounds per head—should be given to these sows on pasture to increase their gains. After the sows (young and mature) are bred, the feeder should return them to pasture and continue to feed some grain, preferably corn and oats in equal parts by weight. About three or four pounds of this grain should be allowed to 300- or 400-pound sows until late in December. Then the feeder must begin feeding ground corn, 2 parts, ground oats, 2 parts, and bran, 1 part. If corn is not available, barley or wheat may be substituted in its place. When the feeds named are not available, selection can be made from the following rations: corn 7 parts, tankage 1 part; corn 2 parts, cowpeas 1 part; barley 2 parts, Canadian field-peas 1 part; corn 2 parts, shorts 2 parts; corn 2 parts, fine alfalfa 2 parts; corn 3 parts, soybeans 1 part.

All these rations are to be mixed by weight. All are improved if mixed well with skimmed milk. Of these mixtures, about five or six pounds per head should be allowed daily. This grain should be fed dry or in a very stiff slop, and pasture allowed. In the northern states and Canada, where the severity of the winter prevents pasturing, the sows should have all the good bright clover, alfalfa or pea hay that they will eat, and daily exercise is essential. Even when sows are closely housed, as in the North, every pregnant sow should be obliged in some way to walk half a mile every day. Lack of exercise is certain to lead to trouble at farrowing time, either with the sows or pigs.

Pregnant sows are liable to constipation, and this is likely to lead to a feverish condition at time of parturition. They should therefore be closely watched, and the bowels regulated by supplying more bulky feed, such as fine alfalfa or clover hay, or better still, more wheat bran.

When the sow is due to farrow she should have a dry, comfortable stall or pen with but little bedding in it. The pigs should be removed as fast as they are born and placed in a basket or barrel on some dry straw. A blanket may be thrown partially over the top of the basket or barrel to keep in the heat, but care must be taken to permit access of air or the pigs will smother before the attendant is aware of it. At the end of three-quarters of an hour, the young pigs may be allowed to nurse, then returned to the barrel for two hours, when they may nurse again and then be left with the sow. The owner or attendant must be present to give close attention to sow and pigs as indicated, or success cannot be expected.

For the first twenty-four hours after the pigs are born, the sow should receive no feed. All the lukewarm water she will drink may be allowed, but nothing more. After this she may be started on a light ration of $\frac{1}{4}$ ground corn, $\frac{1}{4}$ ground oats, and $\frac{1}{2}$ shorts, mixed with skimmed milk, using 3 to 5 pounds of milk to one of grain. This may be

gradually increased until by the end of ten days the sow is receiving all of this slop she will consume. This should be continued for at least two months.

Other grain rations that can be substituted for the one given above are:

In southern states.—Corn 3, cowpeas 2 parts. Corn 2, cowpeas 1 part, mixed with skimmed milk. Corn 3, soybeans 1 part. Corn 5, tankage 1 part.

In far western states.—Barley 1, oats 1, shorts 1 part. Barley 1, shorts 1 part.

In far northern states and Canada.—Barley 2, peas 1, shorts 1 part. Barley 3, peas 1 part. Barley 1, oats 1, shorts 1 part.

All of the above rations are improved by mixing with skimmed milk. The grain should be ground for sows suckling young pigs. Numerous other grain rations could be suggested, but those given are thoroughly satisfactory, usually as cheap as any, and apply to practically all parts of the United States and Canada. No matter which of the above rations is chosen, the sow should be allowed all she will eat, and should also be put on good pasture as soon as possible. The pigs should be given a little of the feed in a small trough of their own, by the time they are three weeks old. They will soon learn to eat, and may then be allowed all they will consume. Any of the grain mixtures recommended for the sows nursing pigs will do for the young pigs, for in feeding the sow we are merely feeding the pigs through the dam.

The pigs must also be kept dry for a week or two, and allowed plenty of exercise. This, with abundant feed, is all they need. As soon as sows and pigs are on good pasture, much less grain feed will be required, but the practice of allowing them all they will eat should be followed until they are at least three months old, for the gains made when the pigs are young are very much cheaper than any made thereafter. After the pigs are of this age, if feeds are high priced, they should be made to depend largely on good pasture, and the grain ration should be cut down to about half of what the pigs would eat. If feeds are cheap, the policy of full-feeding may be continued until the pigs are weaned, which will usually be when the pigs are about four or five months old.

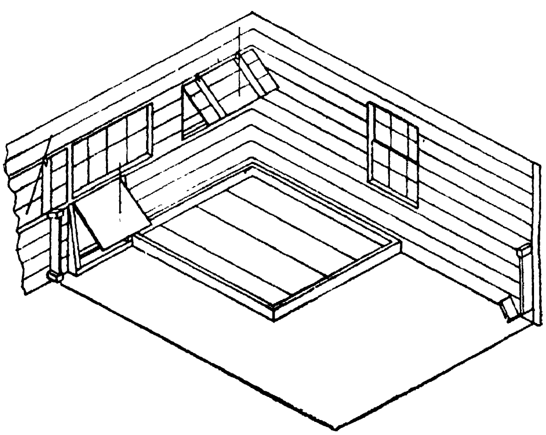


Fig. 656. Overlay of plank on cement floor.

When two litters per year are to be raised, the pigs must be weaned when they are about six weeks old, to permit the sow to flesh up for a couple of weeks before re-breeding. If this is not done, it will seldom be possible to breed the sow as promptly as she should be bred. Pigs weaned at so early an age must be very liberally fed.

Success in managing and feeding breeding sows or young pigs lies in keeping them healthy at all times, and in supplying them with an abundance of food, which will build up bones and muscles. Feeds lacking in protein and ash will not do, and the rations given are those which supply an abundance of the needed elements. Good pasture is one of the cheapest and one of the best feeds.

Finishing the lard hog.

In the corn-belt area of America, where corn is the chief part of the ration, hogs are used to follow the fattening steers, gleaning from their droppings the undigested food which would otherwise be wasted. From this source comes a large part of the food of the fat hogs of the market. They are given the same run as the cattle, and usually given the same amount of shelter, although in the milder parts of the country, where the winters are open and where the only shelter provided for the steers is a windbreak, there should be provided for the swine a shelter from the rain and snow by a temporary roof beneath which a dry sleeping-place is assured.

The manner of feeding these pigs is determined largely by the form in which the corn is fed to the steers and by the quantity and nature of the supplementary feed-stuffs that enter into the ration. The corn is usually fed to the steers as ear corn, chopped corn, shelled corn, soaked shelled corn, corn meal or corn-and-cob meal. The most corn is available for the pigs if shelled corn forms the ration for the steers; the steers consume more corn when it is fed in this form, eating it more rapidly, so that it is less perfectly masticated and more of it passes from the body unaltered. Soaking the corn from one feeding time to the next softens the corn so that less mastication is required, and results in a more nearly perfect digestion, so that much less corn is found in the droppings for the pigs. Grinding the corn for the steers has a result similar to soaking, but with the difference that what corn is found in the excreta, being in a much finer physical condition, is less perfectly gleaned by the swine, while they must work more diligently to get it. Grinding the cob with the corn insures a more complete digestion than of the corn meal alone, with the consequence that the swine following can secure but scant rations from the droppings. The addition of various supplementary foods containing a high percentage of digestible proteids has a marked effect on the utilization of the carbonaceous part of the ration, thus reducing to a minimum the available nutrients in the excreta when fed in conjunction with the less wasteful forms of corn.

When shelled corn alone forms the ration, the preferable practice is to place after the steers an equal number of pigs of about six months of age. They should be fed one-fourth to one-third of a pound of tankage per day, or its available proteid equivalent, in the form of a thin slop, to produce the maximum utilization of the excreted corn. During the first few months of feeding, no other concentrate need be added, but under such management, as the pigs approach ripeness they will practically cease to make gains, and they will not thoroughly glean the corn from the droppings. For the last four or five weeks, therefore, they should be taken from the steer lots and fed as much corn as they will take per day, while in their place younger pigs should be placed after the steers.

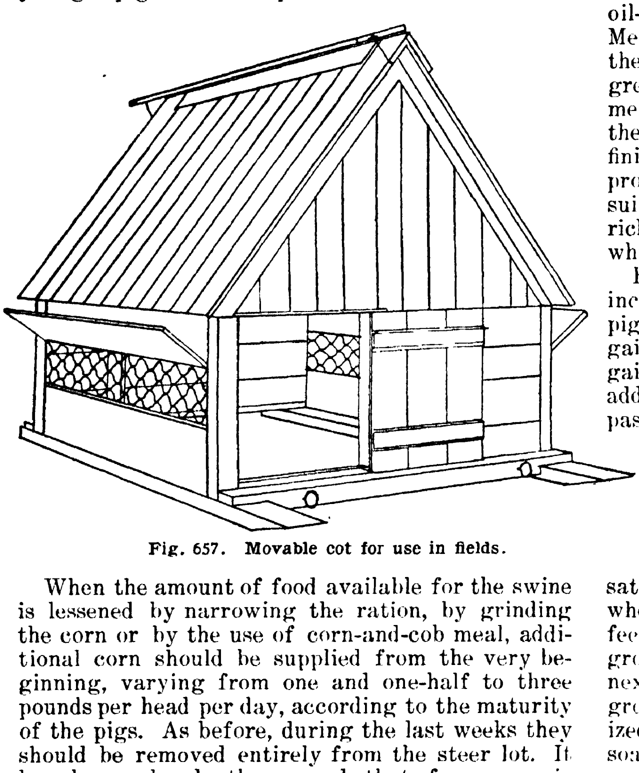


Fig. 657. Movable cot for use in fields.

When the amount of food available for the swine is lessened by narrowing the ration, by grinding the corn or by the use of corn-and-cob meal, additional corn should be supplied from the very beginning, varying from one and one-half to three pounds per head per day, according to the maturity of the pigs. As before, during the last weeks they should be removed entirely from the steer lot. It has been abundantly proved that for economic results from pigs following steers in dry lots, some nitrogenous concentrate should be fed, and that for the finishing period corn must be given in addition to that in the excreta. When hogs follow steers on pasture they will make slightly more economic gains when the only source of protein is the pasturage. As in dry-lot feeding, the pigs should be closely yarded during the final weeks, receiving a ration of corn and tankage, meat meal or shorts, forming a nutritive ratio of 1:7.

By far the greatest number of hogs are fitted for market during the summer and early fall months. During the summer the requirements for shelter, maintenance and labor are least, while gains are greatest and cheapest at this period of the year. Of these summer-fed pigs, much the greater per cent are fattened on pasture. It is found that pigs fed corn alone on blue-grass pasture make equally as great gains as pigs fed in dry lot on a ration balanced with the most suitable proteid-rich foods. However, clover or alfalfa pasture gives much greater gains than a timothy or blue-grass pasture, when corn alone is fed in conjunction. In fact, corn alone on an abundant clover pasture forms almost an ideal ration, excelling a ration of corn and shorts in parts two to one, and almost equaling a ration balanced with tankage or meat meal in rapidity of gains, while it excels all other rations on pasturage when both rate and economy of gains are considered. On pastures other than leguminous ones, it is desirable to use with corn a nitrogenous concentrate. Meat meal, tankage or oil-meal are very desirable foods for this purpose. Meat meal or tankage are most profitably used in the proportion of 1:10 by weight, although slightly greater gains arise from a proportion of 1:5. Oil-meal, having a deleterious effect on the quality of the fats, should not be be used in the last weeks of finishing. Gluten feed, being in itself a corn by-product, and deficient in palatability, is not well suited for the purpose; shorts are not sufficiently rich in protein to give the most profitable results, while wheat bran is too coarse and bulky.

Feeding pigs in the dry lot in the summer markedly increases the cost of production. In dry lots the pigs require more concentrates per hundred pounds gain, are less thrifty, and make noticeably less gains. Under these conditions, the influence of adding protein to the ration is greater than on pasture. The most advantageous rations in dry-lot feeding but slightly excel the feeding of corn alone on timothy pasture, from the standpoint of rate of production, and it is much more costly at all times.

Care must be exercised in the preparation of food for swine. Coarse, bulky foods never give satisfactory results; as a consequence, the use of wheat bran, corn-and-cob meal, oat feed or gluten feed is not recommended. When corn is finally ground, or soaked from one feeding time to the next, there is a more thorough digestion. Coarsely ground corn, especially if it is dry, is poorly utilized. Practically all rations should be mixed and soaked at least twelve hours, while all utensils must be kept sweet.

Winter feeding does not differ essentially from dry-lot feeding during the summer, except that more feed is required per hundred pounds gain. Much of the winter feeding consists in following after steers, which method has been described already.

Finishing the bacon hog.

Throughout North America, bacon hogs are produced chiefly in Canada and parts of those regions of the United States outside the corn-belt. While considerable bacon is manufactured in the United States, much of it is from fat-hog sides and is an inferior quality of meat. There is, however, some feeding of hogs for bacon practiced in the more eastern, the northern and the mountain states.

where the food-stuffs are adapted to this purpose rather than to the production of the fat hog.

In the bacon hog only a moderate degree of fatness is desired, not exceeding an inch in thickness along the spinal column. The fat and lean must be nicely interspersed. But even more essential than the quantity of fat is the quality of it. In bacon production, a common source of trouble arises from the softness of the sides. There is a certain firmness to the fat, a freedom from greasiness and softness which is absolutely essential in No. 1 bacon. This quality is never secured in bacon made from the sides of fat hogs, nor can it be secured where, in feeding, the methods used are similar to those used in feeding fat hogs; neither is the desired quality found in pigs that are carried to extreme weights. The pigs must be marketed between 180 and 220 pounds, after having been fed in a careful manner, if the bacon is to be of the highest grade.

In the production of bacon the feeds entering into the ration must be carefully chosen. Some of the feed-stuffs used for pork-production can be used but sparingly, if at all, for bacon. The use of corn in the proportion larger than one-third of the ration is almost certain to produce softness. Feeding rye or beans exclusively produces similar results. Even an over-abundance of green forage tends to produce a softness in the bacon. The feeds used most largely and successfully are barley, peas, oats, shorts and skimmed milk, and these feeds give best results when mixed rather than when used alone. Although "Canada pea-fed bacon" has had considerable reputation of late years, peas have been a small factor in feeding operations. When used alone they give dry, rather hard, flavorless bacon. Barley is the feed most used. It should be ground or soaked twenty-four hours; it can be fed alone, but gives better results if a small quantity of peas, oil-meal, tankage or finely ground oats is added. Oats are objected to because of their hulls, which for younger pigs necessitates sieving them; with larger pigs careful grinding makes them usable.

Bacon is usually a production of dairy districts, where skimmed milk is always available. Skimmed milk makes an excellent feed, and if supplied in the proportion of 3 to 5 of milk to 1 of meal gives the very best results both in gain and in quality of meat.

Summer feeding on pasture of clover, alfalfa or rape supplies the greater quantity of bacon. Less skimmed milk is required on such pastures, and a protein-rich supplement is not required. One of shorts to two of barley with skimmed milk makes one of the most satisfactory rations. In the northern states there is a greater use of shorts, corn and of small or spoiled wheat. One of corn to two of shorts, or a ration solely of damaged wheat, gives satisfactory results. In Colorado, some bacon is produced on peas alone, gleaned in the field, but so little has been done that conclusions can not be drawn.

Winter feeding is approximately 25 per cent more costly. The succulence supplied by the pastures must be furnished by mangels or sugar-beets, while more tankage, blood meal, oil meal or skimmed milk must be used to balance the ration.

Literature.

For references, see page 646.

Determining the Age of Swine.

By *H. H. Wing.*

While swine have two sets of teeth, temporary and permanent, as in the other domestic animals, the dentition is so irregular as to be of little service in determining the age of the animal. Moreover, the difficulty of catching, holding and examining the animal is so great that the teeth are seldom, if ever, used to determine the age of swine. In market stock, the age does not play an important part, as the value depends entirely on the weight and condition of the animal, except in the case of old sows and stags (castrated mature males). The former are easily distinguished by evidence of having suckled pigs, and the latter by the tusks and the development of the "shield" a coarse heavy fold of muscle under the skin on the shoulder. In breeding animals, the age is always indicated on the certificate of registry of pure-bred stock.

Common Ailments of Swine. Figs. 658–662.

By *John R. Mohler* and *George H. Hart.*

Probably the most important diseases of swine are tuberculosis and hog cholera, which have been described by Dr. Moore on pages 135 and 137. These two diseases have been given the greatest amount of attention by investigators with a view to determining satisfactory methods of prevention and treatment. In addition to these two affections, there are a number of ailments of hogs that cause serious losses, although they have received but scant consideration either from the hog-raiser, veterinarian or investigator. In fact, stockmen are very reluctant to secure the services of a veterinarian for their sick hogs unless the losses are great or the existence of an infectious disease is suspected. Medicines should never be given unless there is a well-defined idea as to what they are expected to accomplish, and "specifics" for hog diseases should be avoided the same as "specifics" for affections of man.

The most satisfactory way of administering medicine to hogs internally is by putting it in their feed or drink, as drenching adult hogs is often dangerous. To no other class of animals is the adage, "an ounce of prevention is worth a pound of cure," so applicable as it is to hogs, and prevention of disease by rational, decent treatment, which includes proper housing, feeding, breeding, and the like, should be given first consideration.

Paralysis or paraplegia.

This is an ailment of hogs, the nature of which is not clearly understood. It is characterized by a progressive paralysis, affecting first the hind-legs and gradually extending over the entire body (Fig.

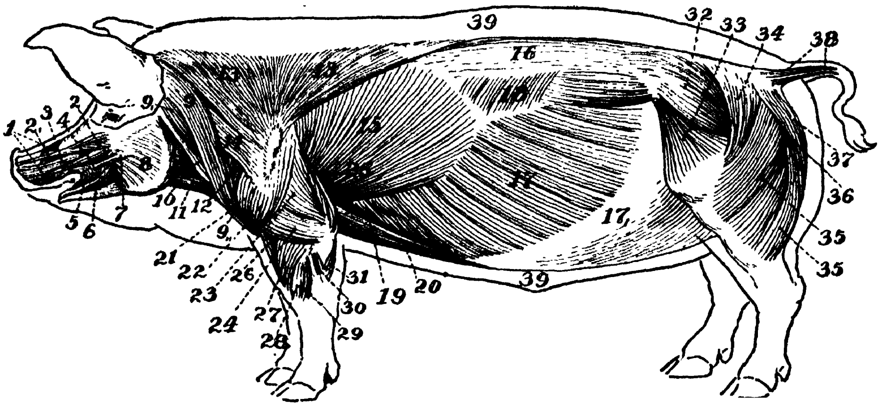


Fig. 658. Muscular system of the hog. 1, Superior levator muscle of the lip; 2, superior levator proprius muscle of the lip; 2_1, accessory muscle to the levator; 3, muscle caninus (pyramidalis); 4, muscle depressorrostrum; 5, muscle orbicularis oris; 6, inferior depressor muscle of the lip, 7, muscle zygomaticus major, 8, masseter muscle; 9, 9_1, 9_2, muscle cleido-mastoideus; 10, muscle sterno-mastoideus; 11, muscle sterno-hyoideus; 12, a small part of the shoulder portion of the trapezius muscle; 13, trapezius muscle; 14, ventral levator muscle of the scapula; 15, latissimus dorsi muscle, 16, dorso lumbar fascia; 17, external oblique abdominal muscle; 17_1, tendinous fescia of external oblique muscle; 18, inferior posterior serratus muscle; 19, portion of anterior serratus muscle; 20, portion of the smaller pectoral muscle; 21, supraspinatus muscle; 22, deltoid muscle; 23, the long head of the triceps muscle; 24, the outer or lateral head of the triceps, 25, muscle tensor fasciæ anti brachii; 26, muscle brachialis anti brachii; 27, muscle extensor carpi radialis; 28, muscle extensor digiti quarti; 29, muscle extensor digiti quinti; 30, muscle extensor carpi ulnaris; 31, muscle palmaris longus; 32, muscle gluteus medius; 33, muscle tensor fasciæ latæ; 34, muscle gluteus maximus; 35, muscle biceps femoris; 36, muscle semi tendinosus; 37, muscle semimembranosus; 38, tail muscle; 39 subcutaneous fat (After Ellenberger.)

659). Excessive feeding of corn has been advanced as a cause in some instances. It has also been said that kidney worms are a causal factor, but they can be excluded, as the disease is frequently seen in hogs which, on postmortem examination, are found to be free from kidney worms, while, on the other hand, many hogs affected with kidney worms do not become attacked with paraplegia. Animals dead of the disease show no constant lesions. The most important symptoms consist in the progressive weakness of the hind-quarters, which is unaccompanied by any general disturbances. The appetite remains good and there is no emaciation until late in the disease.

Treatment.—This consists in deep point-firing of the affected animals with the actual cautery, making eight punctures on each side of the spinal column in the region of the loins. The iron should not be more than one-eighth of an inch thick and should be at a red heat. It is made to penetrate about two inches, so as to pass through the subcutaneous layer of fat into the muscles. The first holes should be made about three inches in front of the tail and one and one-half inches to each side of the median line of the back. They are then continued forward about one and one-half inches apart until eight have been made on each side. A small quantity of vaseline should be rubbed over the punctures. Corn should be withdrawn from the diet. Improvement begins in one to two weeks following the firing, and in the majority of cases complete recovery occurs. Considerable care is demanded in the application of this treatment.

Mange.

This is a not uncommon contagious skin disease of pigs, caused by two varieties of animal parasites, the *Sarcoptes scabiei,* and the *Demodex folliculorum.* The female of the sarcoptes burrows into the skin, giving rise to irritation and the formation of papules, vesicles, pustules and crusts. The crusts are often the initial evidence of the disease noticed by the owner, and appear first about the eyes and ears. From these locations the disease spreads to the neck, inner side of the thighs, flanks, withers and may cover the entire body. There is marked itching, due to the irritation set up by the parasites in the skin. In severe cases there is loss of flesh and unthriftiness, and in young pigs death may occur. The sarcopt of the pig is the largest of its species and can be seen with an ordinary hand-lens by removing the crusts and examining the scrapings from the skin. The disease is contagious, and healthy hogs may contract it from affected hogs, or by being placed in infested pens or yards.

Treatment.— When only a few animals are attacked, the crusts and scabs should be removed by scrubbing with soap and water, followed by the application of a 3 per cent creolin solution or an ointment composed of sulfur 2 drams, resorcin 1 dram, and vaseline in sufficient quantity to make an ounce. Balsam of Peru in ointments, a dram to the ounce, is valuable as a curative agent, but it is expensive. The treatment should be continued daily until all the parasites are destroyed. When large numbers of animals are affected, dipping is the only practical treatment. (Fig. 660.) The animals, however, should not be dipped in cold weather nor should they have mud cakes over the body at the time of dipping. In bad cases, the dip should be rubbed into the skin of the animals by means of a broom or brush. A second dipping should be given at the expiration of six days to kill the young parasites that have hatched since the first treatment. The lime and sulfur dip may be used, consisting of unslaked lime 10 pounds, flowers of sulfur 24 pounds, and water 100 gallons.

Fig. 659. Hog with paralysis.

The *Demodex folliculorum*, causing the other variety of hog mange, lives deep in the hair follicles and sebaceous glands. Its presence causes pustule formations, which rupture and leave small ulcers on the skin. The soft skin is usually attacked, as the snout, neck, belly and inside of the legs. The parasite is present in the pustules in enormous numbers. The outlook for recovery is doubtful, as the parasites are so deep that parasiticides do not reach them. In case the animals are marketable, they should be sent to the butcher at once. Otherwise the treatment as recommended in sarcoptic mange may be tried, but the course of treatment will be necessarily prolonged. [For further information on mange and lice in hogs, see Bureau of Animal Industry, Bulletin No. 69.]

Verminous bronchitis.

This is a common disease of pigs in certain localities, characterized by an inflammation of the bronchial tubes with paroxysms of coughing and stunting of the growth The cause is a small round worm, the *Strongylus paradoxus*, about one inch in length and of the thickness of a thread. It may be present in enormous numbers and completely plug the small bronchial tubes mechanically, giving rise to irritation of the lining membrane.

Fig. 660. Dipping pigs for mange and lice. Ready for the plunge. (Peters.)

The disease is most frequent among young pigs. A large percentage of the animals are usually affected. The owner's attention is first attracted by the paroxysms of coughing, which are very constant. This continues over many weeks; the growth of the animal is stunted and emaciation becomes marked. The diagnosis is made positive in case of doubt by killing one of the worst affected animals and examining the lungs for the presence of the parasites. In making this examination, it is important to open the bronchial tubes longitudinally with the scissors and not crossways, as the worm may be readily overlooked by the latter method.

Care should be taken in purchasing new pigs that they are free from the disease. Young pigs in infested localities should not be allowed to run over low marshy ground, or drink from pools and ditches.

Treatment.—The use of drugs in this disease is rather unsatisfactory. It is better to kill adult pigs for food, in the early stages. In young and half-grown pigs, a teaspoonful of turpentine in milk swill or other fluid food should be given three times daily. Turpentine is excreted by the lungs, numbs the worms, and allows them to be expelled during the fits of coughing.

Black tooth.

Many farmers are inclined to attribute various ailments of swine to the presence of one or more dark-colored teeth in the mouth. As soon as any of the animals become sick the mouth is examined, and in case black teeth are found they are considered sufficient to account for the trouble. This discoloration of the teeth is due to the deposit of tartar, and in the majority of cases can be readily scraped off, leaving the white enamel underneath. Black teeth are often found in the mouths of healthy animals, never produce any abnormal condition, and their presence cannot account for any symptoms the animal may be showing. At the time of shedding the milk teeth and penetration of the permanent teeth through the gums, the latter may become sore and interfere with mastication, but this has no connection with the presence of black teeth.

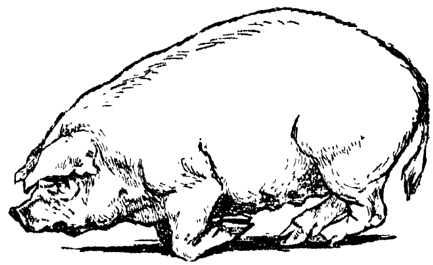


Fig. 661. Hog with rachitis or rickets.

Rachitis or rickets.

This is a bone disease of young pigs, the cause of which is not positively understood. It is thought to be due to errors in diet and to indigestion, together with mal-assimilation of food and lactic acid fermentation, as a result of which there is not sufficient lime deposited in the bones, and they remain too soft.

The affected animals are usually stunted in growth and poorly nourished. There is lameness, with the swelling of the bones about the joints, making the latter appear too large. This is especially noticeable in the hock and pastern joints. The legs may be so weak that they are unable to support the body weight. (Fig. 661.) In some cases the nasal and maxillary bones are involved, and become enlarged to the extent of causing difficult respiration. This form of the disease has been termed "bull nose" and "snuffles." The latter name, however, should not be used in designating rickets [see catarrhal rhinitis, page 656]. The emaciation is often progressive; the animals are unable to move about, and die from weakness or some terminal affection, as pneumonia or enteritis.

Treatment.—Attention to the diet is important. It should consist of concentrated nutritious nitrogenous food. Carbohydrates (starchy foods) are

more likely to undergo fermentation, with lactic acid formation, which is to be avoided. Milk, middlings and bran are valuable. At the same time lime-water should be added to the milk or given to drink. Ground bone-meal may be added to the feed. Sunlight, fresh air, clean quarters and exercise are important. Medicinally, the precipitated phosphate of calcium in one-dram doses, two or three times daily in the feed, together with oil of phosphorus in one-drop doses, is valuable.

Fig. 662. **Hog with sore mouth or canker.**

Sore mouth.

This is an ailment of young pigs, also called necrotic stomatitis and canker of the mouth, affecting the mouth and adjacent structures. It is caused by a specific microörganism, and is frequently associated with constitutional disturbances. The direct cause of the condition is the *Bacillus necrophorus*. It usually appears in winter and lasts until warm spring weather. (Fig. 662.)

The first symptoms noticed are a disinclination to take nourishment and the dropping of saliva from the mouth. On examination is found a congestion of the gums, and in more advanced cases necrotic patches, especially about the region of the front teeth and tusks. The necrosis of the gums may be so extensive that the teeth loosen and fall out. The jaws are swollen, and the lips and snout are frequently cracked and covered with scabs. There is a foul odor to the mouth. The disease often extends to the larynx, pharynx, and in some cases to the nasal cavities. In the latter case, the term snuffles has been applied, but its use should be discouraged when referring to this disease. [See *Catarrhal rhinitis.*] The mucous membrane of the stomach and intestines may become involved, causing an offensive diarrhea. Prostration and emaciation may be excessive. The disease, if untreated, may result fatally in one to five weeks, but with proper treatment nearly all cases recover. The disease may be transmitted to healthy hogs. The association, however, must be intimate, and there must be a break in the continuity of the mucous membrane of the mouth in order that the germ may gain entrance.

Treatment.—The affected animals should be removed from the healthy, and the sheds and pens disinfected by thoroughly saturating them with 5 per cent carbolic acid, or $\frac{1}{1000}$ bichlorid of mercury solution. Medicinally, the mouth should be washed with 2 per cent warm creolin solution to soften and remove the necrotic patches, or the animal may be grasped and its head forced down into the solution contained in a bucket. After washing in this solution, a 10 per cent ointment of salicylic acid or ichthyol may be applied in aggravated cases. The treatment should be repeated daily until the condition is cured.

Catarrhal rhinitis.

Catarrhal rhinitis is an inflammation of the mucous membrane lining the nasal cavities, also called acute coryza or cold in the head. The condition results from exposure to cold, especially when the animal is in a run-down condition, or after over-heating or eating improper food, or getting the surface of the body wet during a cold rain.

The animal appears less active than usual, stands in protected places away from the cold, and may show slight chills. The eyes are red, the appetite is reduced and constipation is present. Soon, a watery discharge appears from the nostrils. In a day or two this becomes thicker and composed of mucus, and later changes to a thick purulent discharge which dries on the nose, occluding the nostrils and giving rise to difficulty in breathing. The animal makes violent snorting efforts to clear the nose, and these may result in rupture of a small blood-vessel in the engorged mucous membrane, and lead to hemorrhage. The blocking of the nostrils, with consequent snuffling, has caused the word snuffles to be used as a synonym for the disease. The use of this term is more or less confusing, as it is used indiscriminately at present to designate the nasal form of rickets, sore mouth, which has extended into the nasal cavity, and catarrhal rhinitis. In rickets, the obstruction is due to enlargement of the bones. While the Germans have used snuffles as a synonym for this disease, it would seem that "bull nose" is more descriptive of the condition. In cases of sore mouth, the term should not be used, as the nasal involvement is merely an extension of the inflammation from the canker in the mouth. The word snuffles in reality refers only to one symptom, and it is doubtful whether it should be used to designate any disease entity. If it is to be used, however, it should be confined to cases of rhinitis, or cold in the head, as in this disease above all others the symptom of snuffling is constant.

Acute coryza usually terminates in recovery in one to two weeks. However, it may run into a chronic nasal catarrh, or complications, as bronchitis or pneumonia, may intervene and lead to a fatal termination.

Treatment.—The animal should be protected from the cold, and have clean, well-lighted quarters. Liquid foods, as milk or slops, should be warmed. Medicinally, $1\frac{1}{2}$ ounces of castor-oil should be given. Fumigation may be tried by placing the animals in an enclosed room and burning tar. Tincture of belladonna leaves in one-half-teaspoonful doses may be added to the feed twice daily to lessen the nasal secretions.

Thumps, or spasm of the diaphragm.

This ailment is common in young pigs, and usually affects the fattest and most thrifty animals in the litter. Thumps is similar to the same condition in horses, which has been described on page 440.

It sets in suddenly and usually occurs as a result of digestive disorders, especially overloading of the stomach. Worms or any other cause of irritation may produce it. Excitement and insufficient exercise may likewise cause it to appear.

The first indication of this trouble is a sudden jerking movement of the flank, which continues at irregular intervals, being more frequent at one time than at another. It may increase in strength, causing a violent thumping or throbbing of the side and producing a backward and forward movement of the body. The animal takes but little exercise, has a poor appetite, and in some cases becomes unthrifty and stunted.

Treatment.—If worms are suspected as the cause of thumps, the pigs should be treated for worms by giving dried sulfate of iron in the swill, at the rate of one-fourth pound of the sulfate for forty pigs, once daily. This treatment may be given for at least a week and continued if necessary. If the condition is caused by indigestion, the quantity of food should be reduced, access given to charcoal or wood-ashes, and as much exercise afforded as possible every day. If practicable, the pigs should be turned on pasture and plenty of opportunity given to run around. At the beginning of the trouble, a physic of two ounces of raw linseed oil, followed with three to ten drops of the tincture of opium in a little oil, should be given every four hours.

Cottonseed poisoning.

This is a peculiar, often fatal poisoning of hogs, resulting from the ingestion of too large a quantity of cottonseed meal, or feeding it over too long a period of time. The acute poisonous principle is not definitely known, although all domestic animals are liable to its effects if fed in sufficient quantities.

The symptoms may follow a single ingestion of the material in those cases in which the animal has got into a bin or feed room and eaten its fill. It more commonly occurs, however, after the hogs have been fed on the material for a period covering several weeks. In some cases there may be several mild attacks, as evidenced by loss of appetite and jerky movements of the flanks (thumps), which pass off in a few days if the cottonseed feed is stopped. In other cases, after the feed has been given for about four weeks the animals, without warning, drop over, kick and squeal for a few moments and die from asphyxia due to edema of the lungs. In these cases, on post-mortem examination there is found an intense congestion and cloudy swelling of the internal organs, with severe inflammation of the gastro-intestinal tract and edema of the lungs.

Treatment.—The positive prevention is the absolute withdrawl of cottonseed meal from the ration of hogs. Cottonseed meal, however, is a valuable food for hogs, and given in the proper quantities it is safe. The amount to be given, as pointed out by Dinwiddie, varies with the weight of the hog, and should be one-fourth pound per day for animals under 50 pounds, one-third pound per day for animals between 50 and 75 pounds, 0.4 pound per day for animals between 75 and 100 pounds, and one-half pound for animals between 100 and 150 pounds.

Inguinal hernia.

Inguinal hernia is a condition extremely common in young male pigs. It consists of the descent of a loop of the intestine into the scrotal sac. It is diagnosed by the enlargement of the affected side of the scrotum, the doughy feeling of the mass, and by the fact that it is reducible in the majority of cases by manipulation or by raising the hind-quarters of the animal. These latter measures cause the protruded part of the intestine to pass back into the abdominal cavity, leaving only the testicle in the scrotum. If not treated, the growth of the animal is frequently stunted, and the intestine may become strangulated and cause death in a short time.

Treatment.—This necessitates the castration of the animal. In young pigs, anesthesia is not necessary. The animal is either suspended by its hind-legs or held on its back with the hind-quarters elevated. An incision is made through the skin directly over the tumor. The hernial sac is separated from the surrounding tissue. When possible, the hernia is reduced without opening the sac. In case adhesions have formed, it is necessary to cut into the sac and separate them before reduction can be accomplished. After the loop of the intestine has been put back into the abdominal cavity, the sac and testicular cord are twisted up to the inguinal ring, which obliterates the sac. A ligature is then applied close to the ring and fixed to the lips of the ring by a suture or two to prevent entwisting of the sac. The testicle is then removed, and the skin wound sutured, a strip of iodoform gauze being inserted for drainage. The other testicle is usually removed at the same time.

Every precaution possible should be taken to prevent infection of the affected parts.

[The following infectious diseases are discussed by Dr. Moore, in addition to hog cholera and tuberculosis mentioned above: Swine erysipelas, page 133; swine plague, page 133.]

Literature.

The literature relating to the diseases of swine will be found in part in books relating to the diseases of other farm stock (which see). Craig and Bitting, Diseases of Swine, Bulletin No. 100, Purdue University, Agricultural Experiment Station; Geo. M. Rommel, The Hog Industry: Selection, breeding and management, Bureau of Animal Industry, Bulletin No. 48; F. D. Coburn, Swine Husbandry: A practical manual for the breeding, rearing and management of Swine, with suggestions as to the prevention and treatment of their diseases; G. T. Brown, The Pig: Its External and Internal Organization; R. Jennings, Sheep, Swine and Poultry, embracing the history and varieties of each, best modes of breeding, their feeding and management, together with the diseases, etc. [For further references, see page 646, and pages 124-146.]

Berkshire Swine. Fig. 663.

By *G. E. Day.*

Berkshire swine are of the "fat-hog" type, and are greatly valued in America, ranking among the first in popularity.

Description.

The Berkshire is a stylish, handsome hog, the best type being of rather more than medium size, although not so large as the Large Yorkshire or the Tamworth. The snout is of medium length, and the face dished. The ears are generally nearly erect, although in the larger strains and in aged animals they frequently incline forward. They should be well carried. The jowl is rather heavy, and the neck short, usually carrying considerable crest. The shoulder, back and rump are of good width, although the back is probably not quite so broad as that of the Poland-China. The ham is thickly meated, and is generally somewhat trimmer in appearance than that of the Poland-China. The Berkshire generally has good depth of body, and indications of a strong constitution. The bone is of excellent quality in the best specimens, and the animal usually stands well on its feet. The standard color is black, with a white mark on the face, white on each foot, and white on the tip of the tail. Sometimes, some of these white markings are absent, and sometimes white occurs on other parts of the body, such as a white blotch on the jowl, on the shoulder, or elsewhere. The standard of excellence prepared by the American Berkshire Association does not disqualify an animal for defective markings, but in selecting breeding-stock, some breeders shun animals too freely marked with white.

Following is the standard of excellence adopted by the American Berkshire Association :

Scale of Points for Berkshire Swine

	Perfect score
1. **Color.**—Black, with white on feet, face, tip of tail and an occasional splash on the arm	4
2. **Face and snout.**—Short, the former fine and well dished, and broad between the eyes	7
3. **Eye.**—Very clear, rather large, dark hazel or gray	2
4. **Ear.**—Generally almost erect, but sometimes inclined forward with advancing age; medium size, thin and soft	4
5. **Jowl.**—Full and heavy, running well back on neck	4
6. **Neck.**—Short and broad on top	4
7. **Hair.**—Fine and soft, medium thickness	3
8. **Skin.**—Smooth and pliable	4
9. **Shoulder.**—Thick and even, broad on top, and deep through chest	7
10. **Back.**—Broad, short and straight; ribs well sprung, coupling close to hips	8
11. **Side.**—Deep and well let down; straight on bottom lines	6
12. **Flank.**—Well back and low down on leg, making nearly straight line with the lower part of side	5
13. **Loin.**—Full and wide	9
14. **Ham.**—Deep and thick, extending well up on back, and holding thickness well down to hock	10
15. **Tail.**—Well set up on back; tapering and not coarse	2
16. **Legs.**—Short, straight, and strong, set wide apart, with hoofs erect and capable of holding good weight	5
17. **Symmetry.**—Well proportioned throughout, depending largely on condition	6
18. **Condition.**—In a good, healthy, growing state; not over-fed	5
19. **Style.**—Attractive, spirited, indicative of thorough breeding and constitutional vigor	5
Perfection	100

History.

The name Berkshire comes from County of Berks in England. The breed is not by any means confined to this county, but is now spread all over the British Isles. The original Berkshire was of ancient origin, and very little is known regarding its origin. The color of the old Berkshire was commonly a sandy, or reddish brown, spotted with black, or white with black spots. It was very much coarser than the present type and possessed lopped ears; but even in its unimproved state, it had a reputation for producing a good quality of meat.

As to the method of improvement, it is said by some that black Siamese boars were used on the old Berkshire sows, and some persons state that white, and black and white Chinese boars, were also used. It is easy to understand how breeds of the type of Siamese and Chinese swine should be eminently well adapted to modifying the original coarse type of Berkshire. Mr. A. B. Allen favors the theory that Chinese blood was used to some extent, and from his investigations in England, fixes the beginning of improvement in the Berkshire by crossing as some time previous to 1780.

In America.—According to Allen, the first importation of Berkshires to America was made in 1823, by John Brentnall of New Jersey. The next importation was in 1832, and great numbers have been brought into the United States since that time. It is stated that the first importation to Canada was made about 1838. Coburn states that for ten years subsequent to 1831, speculation in importing and selling Berkshires at inflated prices was rife in the United States, and that the methods employed by speculators did much to prejudice persons against the breed, and seriously retarded its progress. The breed has outlived this prejudice, however, and has firmly established itself in the confidence of both American and Canadian farmers.

Distribution.

Berkshires are found in every state and territory of the United States, the most important centers being Illinois, Missouri, Indiana, Texas, Ohio, Kansas, Iowa, New York, Michigan, and Tennessee. They also are found in every Canadian province, the province of Ontario taking the lead. They are found in practically all parts of the British Isles, in South America, in Hawaii, and in some European countries.

Types.

The type of the Berkshires is affected by the methods of individual breeders, and, to some extent, by the market demands of the countries in which they are bred. In the United States there was a tendency for some time to breed a fine-boned, somewhat undersized type, emphasizing smoothness and quality rather than size. Fortunately, however, some of the leading American breeders are maintaining both size and quality, and the future of the breed is no doubt safe in their hands. In Canada, owing to the demands of the market for bacon hogs, and owing to the competition of strictly bacon breeds, the tendency on the part of the best Berkshire breeders has been to select for a lengthy, strong-boned type, which, compared with the American type, looks somewhat leggy and coarse, but which, in reality, is a first-class farmer's hog. A good deal is heard at present about the so-called Large English Berkshire. The Large English Berkshire is no different in breeding from the ordinary Berkshire, but in England, as in any other country, the Berkshire will be found to vary more or less in type, and some importers select the larger, stronger-boned animals for importation to America, and call them Large English Berkshires. As a matter of fact, they may be litter mates of animals of the very finest-boned type.

Uses.

The Berkshire is better suited for supplying the market demand for fat hogs than it is for producing bacon hogs. When backs, shoulders, and hams are the main requirements, the Berkshire fits in exceptionally well; but for the export bacon trade in what are known as "Wiltshire sides," the Berkshire has scarcely enough length of side, and has too heavy a neck and shoulder, because the neck and shoulder furnish cuts which are low in price and difficult to sell in connection with a "Wiltshire side." When crossed with the Large Yorkshire or Tamworth, an excellent farmer's hog is the result, although it is perhaps a little nearer to the bacon type than to the fat type. Berkshires have made an exceptionally good showing in the market classes at leading American shows, where they come into competition with other breeds.

It is difficult to secure data regarding the relative early maturity of different breeds, but the Berkshires certainly stand well in this respect. They attain reasonably good weights at an early age and fatten readily. It is a matter of dispute whether they are equal to the Poland-China in point of early maturity, some good authorities placing the Poland-China first, while others would place the Chester-White or Duroc-Jersey at the head of the list. As a matter of fact, it is quite probable that among the best representatives of the breeds mentioned, there is not any very marked difference in point of early maturity.

As an economical converter of feed into pork, the Berkshire is probably not excelled, although it would be too much to say that it leads other breeds in this respect. Breed experiments have been conducted at several agricultural experiment stations, but if we study each individual experiment carefully, we will be forced to the conclusion that the ability to make economical use of food is apparently a question of individuality rather than one of breed. With our present knowledge of the problem, we feel safe in stating that the Berkshire will produce pork as cheaply as any other breed.

The flesh of the Berkshire is of excellent quality, and carries a large proportion of lean to fat.

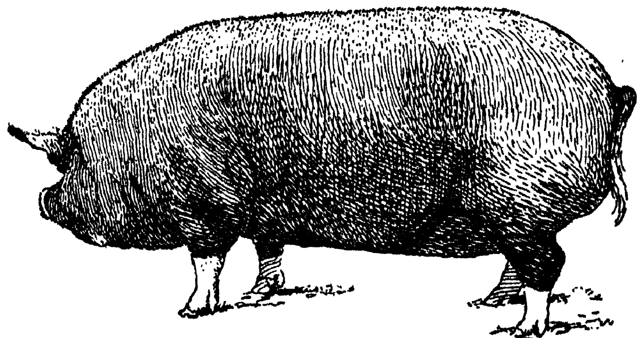


Fig. 663. Berkshire sow.

Investigations regarding the quality of meat from different breeds generally agree in giving the Berkshire a high place both in quantity of lean and fineness of quality. With more length of side, and less tendency for the fat to run unduly thick over the top of the shoulder and neck, the Berkshire would make a capital "Wiltshire side" of bacon.

Berkshire sows of the more lengthy type are prolific, and generally make good mothers. The extremely fine, short type of sow does not, as a rule, produce such large litters. The boars are prepotent, and cross well with almost any other breed, as well as being useful for improving common stock.

Organizations and records.

The American Berkshire Association was organized in 1875, and has the distinction of having started the first record of swine in America. The first herdbook was published in 1877, and up to the present (1908) thirty volumes have been issued, containing the names of 111,540 animals.

Registration of Berkshires in Canada was begun in 1876, and was conducted by the Agriculture and Arts Association until 1891, when the records were taken over by the newly organized Dominion Swine Breeders' Association. The first volume of the Dominion Swine Breeders' Record was published in 1892. This record recorded all breeds of swine represented in Canada. In 1905, the Dominion Swine Records, together with nearly all the live-stock records in Canada, were placed under the direct supervision of the Canadian Department of Agriculture at Ottawa, but are under the control of a "Record Board," comprised of representatives elected by the various breed organizations. This National Live-Stock Record records all breeds of

swine in Canada, but the herdbook still keeps the name of Dominion Swine Breeders' Record. Up to January 1, 1908, eighteen volumes of the record had been published, and 25,804 Berkshire pedigrees recorded.

In England, Berkshires are recorded in the British Berkshire Herdbook, controlled by the British Berkshire Society.

Literature.

For references, see page 646.

Cheshire Swine. Fig. 664.

By *G. E. Day.*

Cheshire swine are a breed of American origin, and may be classed with the fat-hog types. They have not attained much popularity outside of a restricted area in New York state.

Description.

The Cheshire is about medium in size, but some specimens attain heavy weights. It is said that the Cheshire weighs well for its appearance, and is a heavier breed than is generally supposed. Although the body is not noted for depth, it generally has good length, and the shoulders and hams are usually well developed. The face is slightly dished, and the ear rather small and erect. The bone is fine, and of fair quality. The color of the breed is white. Black spots frequently occur on the skin, which, though objectionable, do not disqualify.

Following is the standard of excellence and scale of points adopted by the Cheshire Swine Breeders' Association:

Scale of Points for Cheshire Swine

	Perfect score
1. **Head.**—Short to medium in length, short in proportion to length of body	8
2. **Face.**—Somewhat dished and wide between the eyes	8
3. **Jowl.**—Medium in fulness	3
4. **Ears.**—Small, fine, erect, and in old animals slightly pointing forward	5
5. **Neck.**—Short and broad	3
6. **Shoulders.**—Broad, full and deep	6
7. **Girth around heart**	8
8. **Back.**—Long, broad and straight nearly to root of tail	10
9. **Sides.**—Deep and full; nearly straight on bottom line	7
10. **Flank.**—Well back and low down, making flank girth nearly equal to heart girth	3
11. **Hams.**—Broad and nearly straight with back, and running well down toward hock	10
12. **Legs.**—Small and slim, set well apart, supporting body well on toes	10
13. **Tail.**—Small, slim and tapering	3
14. **Hair.**—Fine, medium in thickness and quantity	3
15. **Color.**—White; any colored hairs to disqualify	2
16. **Skin.**—Fine and pliable; small blue spots objectionable but allowable	3
17. **Symmetry.**—Animal well proportioned, handsome, and stylish; and when grown and well fattened should dress 400 to 600 pounds	8
Perfection	100

History.

The Cheshire originated in Jefferson county, New York, and dates from about 1855. J. H. Sanders, of Chicago, who bred Cheshires for some years, stated in a letter to F. D. Coburn, that he considered the Cheshire to be "simply a derivative of the Yorkshire." The Yorkshire was brought into Jefferson county and used on the white pigs of the district. Early in the sixties hogs of this breed were shown at the agricultural fairs, where they attained some popularity. The Swine Breeders' convention, in a meeting at Indianapolis, Indiana, in 1872, adopted the name Cheshire for the breed. It is thought that Suffolk blood was also used in the combination, which eventually resulted in the Cheshire.

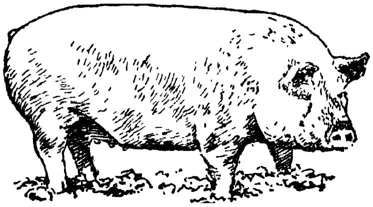


Fig. 664. Cheshire barrow.

Distribution.

The Cheshire is found mainly in New York state, with a few scattered herds in other states, more particularly in certain of the New England and Middle states. The breed has made but little progress, and does not seem likely ever to attain prominence. No doubt a few have been taken into Canada, but none have ever been recorded in the Canadian record.

Types.

In his letter to F. D. Coburn, previously referred to, J. H. Sanders stated that in his herd he had produced "all the different types of Yorkshire, from the Large York down to the Lancashire Short-Face." The type he succeeded in producing "was almost identical, in size, form, and quality, with the most approved medium Berkshire." As bred at present, the type probably does not vary any more than that of other breeds.

Uses.

The Cheshire, as generally seen, belongs more to the fat hog than to the bacon class, although it should not be difficult to develop it into a fairly good bacon breed. It appears to be a good feeder, and its meat is admitted to be of excellent quality. The sows are fairly prolific and breed very readily, and the boars appear to be prepotent, although but little is known regarding their value for crossing purposes.

Organizations and records.

The Cheshire Swine Breeders' Association was organized in 1884, and has published four volumes of its herdbook to date (1908). The first volume appeared in 1889.

Literature.

For references, see page 646.

Chester-White Swine. Fig. 665.

By *G. E. Day.*

The Chester-White is an American breed of swine of the fat- or lard-hog type, but possessing good bacon qualities.

Description.

Some years ago, the Chester-White was rated as the largest breed in the United States, but modern methods of breeding have decreased the size and produced an animal of more quality than the original type. As bred at present, the Chester-White may be ranked as of medium size, or about the same as the Poland-China. The face is straight, or very slightly dished, and the snout is generally somewhat longer than that of the Poland-China. The ear droops, somewhat like that of the Poland-China, although it is generally heavier, and the droop, or break, is usually farther from the tip. It is common for the ear to be somewhat loosely attached to the head. In general conformation, the Chester-White is similar to the Poland-China, although the latter generally excels in depth and fulness of ham.

The color is white, no black hair being admissible, although it is common for black or bluish spots to occur on the skin. In many specimens, the hair has a decided tendency to be wavy, and even curly.

Following is the scale of points adopted by the Standard Chester-White Record Association :

Scale of Points for Chester-White Swine

	Perfect score
1. **Head and face**	4
2. **Eyes**	2
3. **Ears**	2
4. **Neck**	2
5. **Jowl**	2
6. **Shoulders**	6
7. **Chest**	9
8. **Back and loin**	15
9. **Sides and rib**	8
10. **Belly and flank**	6
11. **Hams and rump**	10
12. **Feet and legs**	10
13. **Tail**	1
14. **Coat**	2
15. **Color**	5
16. **Size**	5
17. **Action and style**	4
18. **Condition**	4
19. **Disposition**	3
Perfection	100

Disqualifications.

Form.—Upright ears; small cramped chest; crease around back of shoulders and over the back, causing a depression easily noticed ; feet broken down, causing the animal to walk on pastern joints ; deformed or badly crooked legs.

Size.—Chuffy, or not two-thirds large enough for age.

Condition.—Squabby fat; deformed, seriously deformed; barrenness ; total blindness.

Score.—Less than sixty points.

Pedigree.—Not eligible to record.

Color.—Black or sandy spots in hair.

Detailed description.

1. *Head and face.*—Head short and wide ; cheeks neat but not too full ; jaws broad and strong ; forehead medium, high and wide. Face short and smooth ; wide between the eyes ; nose neat and tapering and slightly dished.

Objections.—Head long, narrow and coarse ; forehead low and narrow ; jaws contracted and weak. Face long, narrow and straight ; nose coarse, clumsy or dished like a Berkshire.

2. *Eyes.*—Large, bright, clear and free from wrinkles or fat surroundings.

Fig. 665. Chester-White boar.

Objections.—Small, deep or obscure ; vision impaired in any way.

3. *Ears.*—Medium size, not too thick ; soft ; attached to the head so as not to look clumsy ; pointing forward and slightly outward ; fully under the control of the animal and drooping so as to give a graceful appearance.

Objections.—Large, upright, coarse, thick, round, too small ; drooping too close to the face, animal not being able to control them.

4. *Neck.*—Wide, deep, short, and nicely arched.

Objections. Long, narrow, thin, flat on top ; tucked up ; not extending down to breast-bone.

5. *Jowl.*—Full, smooth, neat and firm ; carrying fullness back to shoulder and brisket when the head is carried up level.

Objections.—Light ; too large and flabby ; rough and deeply wrinkled ; not carrying fullness back to shoulder and brisket.

6. *Shoulders.*—Broad, deep and full, extending in a straight line with the side, and carrying size down to line of belly.

Objections.—Narrow at top or bottom, not full nor same depth as body ; extending above line of back ; shields on boars too coarse and prominent.

7. *Chest.*—Large, deep and roomy, so as not to cramp vital organs ; full in girth around the heart, the breast-bone extending forward so as to show slightly in front of legs, and let down so as to be even with line of belly, showing a width of not less than seven inches between fore-legs of a full-grown hog.

Objections.—Narrow, pinched ; heart girth less than flank girth ; too far let down between fore-legs ; breast-bone crooked or too short.

8. *Back and loin.*—Back broad on top, straight or slightly arched ; uniform width, smooth, free from lumps or rolls ; shorter than lower belly line ; same height and width at shoulder as at ham ; loin wide and full.

Objections.—Back narrow, creased back of shoulders ; sun-fish shaped, humped, swayed, too long, or lumpy rolls; uneven in width ; loin narrow, depressed or humped.

9. *Sides and ribs.*—Sides full, smooth, deep, carrying

size down to belly; even with line of ham and shoulder; ribs long, well sprung at top and bottom, giving hog a square form.

Objections.—Flat, thin, flabby, compressed at bottom; shrunken at shoulders and ham; uneven surface; ribs flat and too short.

10. *Belly and flank.*—Same width as back, full, making a straight line and dropping as low at flank as at bottom of chest; line of lower edge running parallel with sides; flank full and even with body.

Objections.—Belly narrow, pinched, sagging or flabby; flank thin, tucked up or drawn in.

11. *Hams and rump.*—Ham broad, full, long, wide and deep, admitting of no swells; buttock full, neat and clean, thus avoiding flabbiness; stifle well covered with flesh, nicely tapering towards the hock. Rump should have a slightly rounding shape from loin to root of tail; same width as back; making an even line with sides.

Objections.—Hams narrow, short, not filled out to stifle; too much cut up in crotch or twist, not coming down to hocks; buttocks flabby. Rump flat, narrow, too long, too steep, sharp or peaked at root of tail.

12. *Legs and feet.*—Legs short, straight, set well apart and squarely under body; bone of good size, firm, well muscled; wide above knee and hock; below knee and hock round and tapering, enabling animal to carry its weight with ease; pastern short and nearly upright. Feet short, firm, tough and free from defects.

Objections.—Legs too short, long, slim, crooked, too coarse; too close together; weak muscles above hock and knee; bone large and coarse without taper; pasterns long, crooked, slim like a deer's; hoofs long, slim, weak; toes spreading, crooked or turned up.

13. *Tail.*—Small, smooth, tapering, well set on; root slightly covered with flesh; carried in a curl.

Objections.—Coarse, long, clumsy, set too high or too low; hanging like a rope.

14. *Coat.*—Fine, straight or wavy; evenly distributed and covering the body well; nicely clipped coats no objection.

Objections.—Bristles, hair coarse, thin, standing up, not evenly distributed over all of the body except the belly.

15. *Color.*—White (blue spots or black specks in skin shall not argue impurity of blood.)

Objections.—Color any other than white.

16. *Size.*—Large for age and condition; boars two years old and over, if in good flesh, should weigh not less than 500 pounds; sow same age and condition, not less than 450 pounds. Boars eighteen months old in good flesh should weigh not less than 400 pounds; sows, 350. Boars twelve months old, not less than 300 pounds; sows, 300. Boars and sows six months old, not less than 150 pounds each; and other ages in proportion.

Objections.—Overgrown, coarse, uncouth, hard to fatten.

17. *Action and style.*—Action easy and graceful, style attractive; high carriage; in males, testicles should be readily seen; same size and carriage.

Objections.—Sluggish; awkward, low carriage, wabbling walk; in males, testicles not easily seen, not of same size or carriage, or only one showing.

18. *Condition.*—Healthy; skin clear and bright, free from scurf and sores; flesh fine and mellow to the touch; evenly laid on and free from lumps; good feeding qualities.

Objections.—Unhealthy; skin scaly, scabby or harsh; flesh lumpy or flabby; hair harsh, dry and standing up from body; poor feeders; total deafness.

19. *Disposition.*—Quiet, gentle and easily handled; with ambition enough to look out for themselves if neglected.

Objections.—Cross; restless, vicious or wild; no ambition.

History.

Most authorities on this breed recognize three strains of Chester-White swine, the origin of which may be briefly summed as follows:

(1) *The original Chester-White* originated in Chester county, Pennsylvania, whence the name. Large, white pigs were common in Chester county many years ago. They were taken there by the earliest settlers, although just where these original pigs came from is not altogether clear. About the year 1818, Captain James Jeffries imported from England a pair of white pigs, which are spoken of as Bedfordshire pigs, and as Cumberland pigs. Captain Jeffries used the boar on the native white pigs of the district with good results. Later, it is stated, white Chinese pigs were imported to Chester county and crossed on the native pigs. Eventually the different strains of blood were combined, and from this combination came the original Chester-White breed.

(2) *Todd's Improved Chester-White* has a somewhat complicated history. About 1827, Norfolk Thin Rind pigs were imported from England to Connecticut. Two brothers, named Todd, bought a boar of this breed, and a sow of what was called the Grass breed, and took them to Ohio, where they were bred together with considerable success. Later, a Joseph Haskins brought to Ohio a boar of the Byfield breed, and a sow similar to the original Todd sow. The Todd and Haskin pigs were freely bred together. Isaac Todd also used other boars in his herd, one of which was said to have been of the large Grass breed, and another was called a Normandy boar; little is known of the breeding of either. Both of these boars were white in color. In 1865, Isaac Todd introduced Chester-White blood. His son, S. H. Todd, made further use of the Chester-White, and by careful breeding and selection evolved what is known as Todd's Improved Chester-White.

(3) *The Ohio Improved Chester-White* is the product of the efforts of L. B. Silver, of Ohio, who, in 1865, began breeding Chester-Whites, and who aimed to produce a superior type through selection.

Distribution.

The Chester-White is largely distributed over the United States. It is very popular in the eastern states, and is strongly represented in Ohio, Indiana, Illinois, Iowa, Michigan, Wisconsin, Pennsylvania and other states. It has also spread to the South, to some extent at least, and seems to be giving satisfaction. For some reason it has gained a much stronger foothold in Canada than the Poland-China, probably because it seems more easily bred to a lengthy type than the Poland-China.

Types.

The Chester-White is capable of showing extreme variations of type in the hands of different breeders. In American show-rings, the short-legged, fine-boned, deep, thick, smooth type is generally preferred by the judges, who seem willing to sacrifice considerable size in order to get smoothness and quality. Larger, heavier-boned,

types occasionally appear, but are generally discouraged by the judges. In Canada, greater importance is attached to length, and some very lengthy, heavy-boned Chester-Whites are frequently seen in Canadian show-rings. At the 1907 Provincial Winter Fair, at Guelph, Ontario, a pair of Chester-White carcasses were exhibited in the bacon class in competition with Yorkshires, Tamworths and Berkshires, and though they were not ideal bacon carcasses by any means, they were good enough to win sixth prize; and a number of Yorkshire and Tamworth carcasses, together with all the Berkshire carcasses, were ranked below them. Any person who has seen the unequaled exhibit of bacon carcasses at Guelph, will understand that these hogs must have been about as far away in type from the American prize-winning Chester-White as it is possible to get. This is an extreme case, but it illustrates the possibilities of the breed under different systems of selection and feeding. As to the different strains mentioned in the history of the breed, they have now all assumed very much the same type.

Uses.

Although the Chester-White can be made to approach the bacon type through selection and feeding, as mentioned in the preceding paragraph, it can never be made an ideal bacon hog, and it seems like a waste of energy to attempt to make it a bacon breed when first-class bacon breeds are already available. The Chester-White is especially adapted to the fat-hog trade, and will no doubt continue as such. Crosses of the Chester-White with the Large Yorkshire and Tamworth have given very satisfactory results in Canada, and it is only through crossing that Chester-White blood can be used successfully in the bacon trade. For the requirements of the American packer, the Chester-White is eminently well suited.

The quality of meat produced by the Chester-White is good, but is somewhat lacking in lean. It is generally conceded that the Yorkshire, Tamworth and Berkshire produce more lean in proportion to fat.

In early maturity, the Chester-White compares favorably with other breeds, and it is an economical producer of meat. In feeding trials it has given a good account of itself, but, as previously stated, no breed can claim superiority over other breeds in this respect, so far as we can judge from experimental work and from practical experience. The Chester-White is also a good grazer, and in this feature probably excels the Yorkshire and the Tamworth, which are better adapted to pen feeding.

It is said that the Chester-White, as a breed, is somewhat more prolific than the Poland-China and the fine type of Berkshire. The assertion is supported by the findings of Dr. A. W. Bitting, who investigated the matter in 1897.

For crossing purposes, the Chester-White is highly esteemed, a cross with the Poland-China being regarded with especial favor by feeders. The grade Chester-White sow is a very useful farmer's pig, and pure-bred boars are very effective in improving common stock.

Organizations and records.

The American Chester-White Record Association took over the business of the Chester-White Record Association in 1894. The Chester-White Record Association was organized in 1884, to support Todd's Improved Chester-White Swine, and issued four volumes previous to 1894, when it was changed to the American Chester-White Record. Thirteen volumes of the Record have been published to date (1908), with 18,528 registrations. The Ohio Improved Chester-White Swine Breeders' Association was organized in 1897. For registration in the herdbook of this Association, pedigrees must trace to the herd of L. B. Silver, who has already been referred to as the originator of the Ohio Improved Chester-White, or the O. I. C. strain, as it is generally called. The Standard Chester-White Record Association was organized in 1890, and has issued thirteen volumes of its herdbook to date (1908), containing 31,877 registrations. The National Chester-White Record Association was organized in 1880, and has published twelve volumes of its herdbook, containing over 18,000 registrations.

In Canada, Chester-Whites are recorded in the Dominion Swine Breeders' Record, and 6,261 animals have been recorded to date (1908).

Literature.

The American Chester-White Record Association has undertaken the publication of an annual called "The Annual Chester-White Bulletin," which contains some information regarding the breed, names of breeders and advertisements. "The Chester-White Hog Breeders' Directory," by Frank F. Moore, Secretary of the Standard Chester-White Record Association, contains considerable information, of interest to Chester-White breeders. [For further references, see page 646.]

Duroc-Jersey Swine. Figs. 666, 667.

By *G. E. Day.*

The Duroc-Jersey is an American breed of swine, and is of the fat- or lard-hog type.

Description.

The Duroc-Jersey is similar in size to the Chester-White and the Poland-China. Some specimens are of very large size, but the tendency of modern breeding is toward a medium size, with rather fine bone. It is possible that breeders are going too far in reducing the size of the animal and the weight of its bone, and the larger, heavier-boned hog will always find an important place in this breed, as, indeed, in all others. The snout is of medium length; the face slightly dished; the ear drooped, much the same as that of the Poland-China; the jowl heavy; the body wide and deep, set on short legs of medium to fine bone; the ham heavily fleshed, and the body generally noted for thickness rather than for length. Cherry-red is the

popular color, but yellowish red and chestnut are frequently seen. A few black spots on belly and legs do not disqualify, but are objectionable. Black markings on any other parts of the body are very serious objections.

Following is the scale of points and description adopted by the American Duroc-Jersey Record. It gives in detail the points desired in the breed and as well the characters that are undesirable avoided.

Scale of Points for Duroc-Jersey Swine

	Perfect score
1. **Head and face**	4
2. **Eyes**	2
3. **Ears**	2
4. **Neck**	2
5. **Jowl**	2
6. **Shoulders**	6
7. **Chest**	12
8. **Back and loin**	15
9. **Sides and ribs**	8
10. **Belly and flank**	6
11. **Hams and rump**	10
12. **Legs and feet**	10
13. **Tail**	1
14. **Coat**	2
15. **Color**	2
16. **Size**	5
17. **Action and style**	4
18. **Condition**	4
19. **Disposition**	3
Perfection	100

Disqualifications.

Form.—Ears standing erect; small cramped chest, and crease back of shoulders and over back so as to cause a depression in the back easily noticed; seriously deformed legs, or badly broken-down feet.

Size.—Very small, or not two-thirds large enough as given by the standard.

Score.—Less than fifty points.

Pedigree.—Not eligible to record.

Detailed description.

1. *Head and face.*—Head small in proportion to size of body; wide between eyes; face nicely dished (about half way between a Poland-China and a Berkshire), and tapering well down to the nose; surface smooth and even.

Objections.—Large and coarse; narrow between the eyes; face straight; crooked nose, or too much dished.

2. *Eyes.*—Lively, bright and prominent.

Objections.—Dull, weak and obscure.

3. *Ears.*—Medium, moderately thin, pointing forward, downward and slightly outward, carrying a slight curve; attached to head very neatly.

Objections.—Very large, nearly round, too thick, swinging or flabby; not of same size; different position and not under control of animal.

4. *Neck.*—Short, thick and very deep and slightly arching.

Objections.—Long, shallow and thin.

5. *Jowl.*—Broad, full and neat; carrying fulness back to point of shoulders and on a line with breast-bone.

Objections.—Too large, loose and flabby; small, thin and wedging.

6. *Shoulders.*—Moderately broad, very deep and full; carrying thickness well down and not extending above line of back.

Objections.—Small, thin, shallow; extending above line of back. Boars under one year old heavily shielded.

7. *Chest.*—Large, very deep, filled full behind shoulders; breast-bone extending well forward so as to be readily seen.

Objections.—Flat; shallow, or not extending well down between fore-legs.

8. *Back and loin.*—Back medium in breadth; straight or slightly arching; carrying even width from shoulder to ham; surface even and smooth.

Objections.—Narrow, crease behind shoulders; swayed or humped back.

9. *Sides and ribs.*—Sides very deep, medium in length; level between shoulders and hams, and carrying out full down to line of belly. Ribs long, strong, and sprung in proportion to width of shoulders and hams.

Objections.—Flabby, creased, shallow, and not carrying proper width from top to bottom.

10. *Belly and flank.*—Straight and full and carrying well out to line of sides. Flank well down to lower line of sides.

Objections.—Narrow; tucked up or drawn in; sagging or flabby.

11. *Hams and rump.*—Broad, full and well let down to the hock; buttock full and coming nearly down and filling full between hocks. Rump should have a round slope, from loin to root of tail; same width as back and well filled out around tail.

Objections.—Ham narrow, short, thin, not projecting well down to hock; cut up too high in crotch. Rump narrow, flat or peaked at root of tail; too steep.

12. *Legs and feet.*—Medium size and length, straight, nicely tapered, wide apart and well set under the body; pasterns short and strong. Feet short, firm, and tough.

Objections.—Legs extremely long, or very short, slim, coarse, crooked; legs as large below knee and hock as above; set too close together; hocks turned in or out of straight line. Feet, hoofs long, slim and weak; toes spreading or crooked.

13. *Tail.*—Medium; large at base and nicely tapering, and rather bushy at end.

Objections.—Extremely heavy; too long and ropy.

14. *Coat.*—Moderately thick and fine; straight, smooth and covering the body well.

Objections.—Too many bristles; hair coarse, harsh and rough, wavy or curly; swirls, or not evenly laid over the body.

15. *Color.*—Cherry-red, without other admixtures.

Objections.—Very dark red or shading brown; very pale or light red; black spots over the body; black flecks on belly and legs not desired but admissible.

16. *Size.*—Large for age and condition. Boar two years old and over should weigh 600 pounds; sow same age and condition, 500 pounds. Boar eighteen months, 475 pounds; sow, 400 pounds. Boar twelve months, 350 pounds; sow, 300 pounds. Boar and sow pigs six months, 150 pounds. The figures are for animals in a fair show condition.

Objections.—Rough and coarse and lacking in feeding qualities.

17. *Action and style.*—Action vigorous and animated. Style free and easy.

Objections.—Dull or stupid; awkward and wabbling. In boars, testicles not easily seen nor of same size or carriage; too large or only one showing.

18. *Condition.*—Healthy; skin free from scurf, scales, sores and mange; flesh evenly laid over the entire body and free from any lumps.

Objections.—Unhealthy, scurfy, scaly, sores, mange; too fat for breeding purposes; hair harsh and standing up; poor feeders.

19. *Disposition.*—Very quiet and gentle; easily handled or driven.

Objections.—Wild, vicious or stubborn.

History.

Red pigs have existed in the United States for a great many years, and there seems to be no satisfactory account of their origin. It is said that slave traders brought in a red breed of hogs from western Africa, known as the Guinea breed. It is also stated that Henry Clay imported Spanish red pigs in 1837, and that Daniel Webster brought red pigs from Portugal in 1852. It is further stated that the Berkshire, which, in its early days was freely marked with red or sandy hair, is responsible for some of the red pigs. Whatever breeds, or mixture of breeds, were responsible, it is certain that a large breed of red hogs attained to considerable prominence in New Jersey, and was eventually given the name of Jersey-Red. The Jersey-Red had large lop ears, and good length of body. It was rather long in the leg, and coarse in bone and hair. It was valued because of its size, strong constitution, and rapid growth.

The Duroc originated in Saratoga county, New York, and, to put it briefly, resulted from crossing a red boar on the common sows of the district. It is uncertain whether the boar came merely from another part of New York state, or from England. It is said that the boar was named "Duroc" after a famous stallion, and hence the name of the breed. The Duroc also had lopped ears, but it was a much finer type of pig than the Jersey-Red.

In the course of time, the breeders of Jersey-Reds and Durocs came together, and the two breeds were blended into one, under the name of Duroc-Jersey. The amalgamation took place in 1883.

Distribution.

The Duroc-Jersey is found in a great many states, the most important of which are Iowa, Illinois, Nebraska, Kansas, Missouri, Indiana, Ohio, Minnesota, Oklahoma, Texas, Kentucky, Tennessee, Michigan and Wisconsin. The breed is also largely represented in many other states. The breed has been introduced into Canada, but has not made much progress as yet in that country. It is practically unknown outside the United States and Canada.

Fig. 666. Duroc-Jersey sow.

Types.

Like other breeds, Duroc-Jerseys present variations in type. On the whole, breeders have been striving for a fine-boned, smooth type of hog of medium size. It is asserted by some persons that this refining process has been carried too far, and breeders are to be found who are producing hogs of more bone and more size. These larger, heavier-boned hogs are attracting considerable attention among Duroc-Jersey breeders, and it would seem that they would yet perform an important work for the breed.

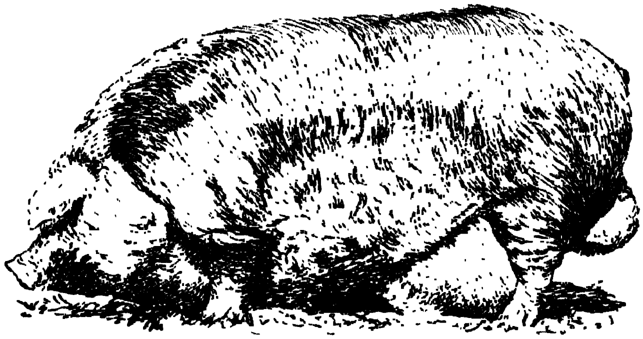


Fig. 667. Duroc-Jersey boar.

Uses.

The Duroc-Jersey is essentially a producer of fat or lard hogs, and it seems to be meeting the demands of the American packer in a satisfactory manner. As a bacon hog, it is not a success.

It is an early maturing hog, and makes economical gains, as has been demonstrated by experiments. It must be repeated again, however, that individuality is much more important than breed in regard to economy of production. It is safe to say that the Duroc-Jersey will make as cheap gains as any other breed. The Duroc-Jersey has considerable reputation as a grazer, and also takes kindly to corn-feeding. It has an advantage over most white breeds, in that its skin does not blister with the sun, and it is therefore gaining favor in the South. The meat of the Duroc-Jersey is similar to that of the Chester-White and the Poland-China when fed under the same conditions. If fed a mixed ration, it is capable of producing meat with a good proportion of lean.

The Duroc-Jersey, for a fat hog, is prolific, although it can hardly be said to equal the Large Yorkshire and the Tamworth in this respect.

The Duroc-Jersey crosses well with other breeds, and a cross with the Poland-China and the Berkshire is very popular. The boars do excellent work as improvers of common stock.

Organizations and records.

The American Duroc-Jersey Swine Breeders' Association was organized in 1883, but it was not incorporated until 1888. The first herdbook was published in 1885, and twenty-five volumes have been issued since, containing 38,000 registrations. The National Duroc-Jersey Record Association was organized in 1891, and published its first herdbook in 1893. It has published twenty-eight volumes to date, containing 130,000 registrations. In Canada,

Duroc-Jerseys are recorded in the Dominion Swine Breeders' Record, but only 1,079 animals have been recorded to date.

Literature.

"The Duroc Bulletin" is a semi-monthly paper published at Peoria, Illinois, in the interests of Duroc-Jersey swine. The Duroc-Jersey is the only breed of swine having a paper published solely in its interests, although some other associations publish yearbooks or directories for their respective breeds. [For further references, see page 646.]

Essex Swine. Fig. 668.

By *G. E. Day.*

The Essex is a small, easily fattened pig of the American or fat-hog type. It originated in England.

Description.

The Essex must be classed with the small breeds, being, as a breed, decidedly smaller than the Berkshire or the Poland-China. It is a short, thick, deep, chunky type of pig, with short, fine-boned legs. The snout is short, the face dished, the forehead broad, and the ears small, fine and erect, but inclined to droop slightly with age. The neck is very short, and the shoulders and hams largely developed. Altogether, it is a very smooth, compact type of hog. The color is all black, no white being admissible.

Following is the scale of points adopted by the American Essex Association :

Scale of Points for Essex Swine	Perfect score
1. **Color.**—Black	2
2. **Head.**—Small, broad and face dished	3
3. **Ears.**—Fine, erect, slightly drooping with age	2
4. **Jowl.**—Full and neat	1
5. **Neck.**—Short, full, well arched	3
6. **Shoulders.**—Broad and deep	7
7. **Girth around heart**	6
8. **Back.**—Straight, broad and level	12
9. **Sides.**—Deep and full	6
10. **Ribs.**—Well sprung	7
11. **Loin.**—Broad and strong	12
12. **Flank.**—Well let down	2
13. **Ham.**—Broad, full and deep	12
14. **Tail.**—Medium, fine and curled	2
15. **Legs.**—Fine, straight and tapering	3
16. **Feet.**—Small	3
17. **Hair.**—Fine and silky, free from bristles	3
18. **Action.**—Easy and graceful	4
19. **Symmetry.**—Adaptation of the several parts to each other	10
Perfection	100

History.

The Essex pig takes its name from the county of Essex in England. The original Essex pig was an extremely undesirable feeder's type, being coarse in bone, flat in the rib, and long in the leg. It was hard to fatten and slow to mature. In color it was generally black and white. In 1830, Lord Western imported black Neapolitan pigs from Italy, and crossed them with the Essex pigs. In the course of time he evolved a type that was a wonderful improvement on the old Essex, and it is said that he used other blood than that of the Neapolitan. It is stated that Lord Western inbred too closely, and that his pigs became weak in constitution and lacking in fecundity.

Soon after Lord Western began his work of improvement, one of his tenants, named Fisher Hobbes, took up the breeding of Essex–Neapolitan pigs, and in his hands the breed was much improved, increasing in size and improving in constitution and breeding qualities. The Hobbes' strain was called Improved Essex, and gained in popularity very rapidly.

In America.—It is said that some of the old Essex pigs existed in the United States as early as 1820. When the Improved Essex had established its reputation, importations to America became common, and large numbers were brought out, but of late years very few importations have been made.

Distribution.

The Essex has spread from its native county into several other English counties. It has been exported to several European countries, to Australia, Canada and the United States. It would be

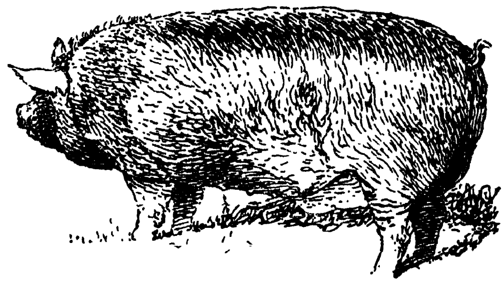


Fig. 668. Essex boar.

difficult to select any state as an important center for this breed, but it occurs, scattered here and there in small lots, in a large number of states. It has become very popular in the South.

The Essex has nearly disappeared from Canada, only one or two herds being left. None of the Canadian exhibitions make a separate class for this breed.

Types.

To meet the modern demand, many breeders of Essex swine are striving to develop a type with more size, heavier bone, and greater length. That they are meeting with some degree of success is evidenced by the types of Essex placed on exhibition at some of the fairs during the past few years. This recent type gives more promise of present-day utility than the type we have been accustomed to see.

Uses.

The Essex belongs to the extremely quick maturing, easily fattened type. Its lack of size prevents

it becoming popular with the general farmer, and it is more suited to the requirements of the villager, who keeps one or two pigs, and who wishes to use the minimum amount of food. He will not have so many pounds of pork, but he will have a finished hog with a small outlay. The breed is regarded as being a cheap producer of meat, and no doubt such is the case; but it would not be safe to assume that it will always produce meat at a lower cost than larger breeds. The meat from the Essex is fine-grained, but excessively fat.

The sows are not regarded as prolific, but a great deal depends on how they are fed and managed.

For cross-breeding, the Essex is suitable for crossing with unduly coarse types. In the past, it played an important part in improving other breeds, but as the breeds of swine have been brought to a finer type, the field of the Essex has become narrowed, until the breed is now more famous for what it has accomplished than for what it is capable of doing at present. About the only important opening for it in the United States at present, is the conquest of the "Razorback" of the South, and on this mission it has already set forth.

Organizations and records.

The American Essex Association was organized in 1887, but its membership is not large. It has published two volumes of its record, which contain some 1,500 names. In Canada, Essex swine are recorded in the Dominion Swine Breeders' Record, but only 286 animals have been recorded to date (1908). In England, they are recorded in the herd book of the National Pig Breeders' Association.

Literature.

For references. see page 646.

Hampshire or Thin Rind Swine. Fig. 669.

By *G. E. Day.*

The Hampshire or Thin Rind is said to be a bacon hog, but it may be placed more correctly between the bacon and fat-hog types.

Description.

The Hampshire is only medium in size, and, if there is any difference, it will scarcely equal the Chester-White and the Duroc-Jersey in weight. The face is straight, and the ear is inclined forward but does not droop like that of the Poland-China. The jowl is lighter than that of the general run of fat hogs, as is also the shoulder and the ham. The back is of medium width, and the side has fair length but is not so deep as that of a typical fat hog. The legs are of medium length, and the bone is of good quality. It may be described as between the bacon and the fat type. Mr. H. F. Work, at one time Secretary of the American Hampshire Association, describes the color as follows: "In color, they are either listed or blacks, the most fashionable colors consisting of black extremities with a white belt four to twelve inches wide, encircling the body and including the fore-legs, which should also be white." The term "listed" means that the white belt is present. Mr. Work further states that there are some breeders who try to run their herds all black, and asserts that breeders should not be too particular regarding color, except in cases when white spots occur.

Following is the standard of excellence adopted by the American Hampshire Swine Record Association:

SCALE OF POINTS FOR HAMPSHIRE SWINE

Disqualifications.

Color.—Spotted or more than two-thirds white.

Form.—Any radical deformity, ears very large or dropping over eyes, crooked or weak legs or broken-down feet.

Condition.—Seriously impaired or diseased, excessive grossness, barrenness in animals over two years of age, chuffy or squabby fat.

Size.—Not two-thirds standard weight.

Pedigree.—Not eligible to record.

	Perfect score
1. **Head and face.**—Head medium length, rather narrow, cheeks not full; face nearly straight and medium width between the eyes, surface even and regular	4
Objections: Head large, coarse and ridgy; nose crooked or much dished.	
2. **Eyes.**—Bright and lively, free from wrinkles or fat surroundings	2
Objections: Small, deep or obscure, or vision impaired by fat or other cause.	
3. **Ears.**—Medium length, thin, slightly inclined outward and forward	2
Objections: Large, coarse, thick, large or long knuck, drooping or not under good control of the animal.	
4. **Neck.**—Short, well set to the shoulders, tapering from shoulder to head	2
Objections: Long, thick or bulky.	
5. **Jowl.**—Light and tapering from neck to point, neat and firm	2
Objections: Large, broad, deep, or flabby.	
6. **Shoulders.**—Deep, medium width and fulness, well in line with back	6
Objections: Narrow on top or bottom, thick beyond line with sides and hams.	
7. **Chest.**—Large, deep and roomy; full girth, extending down even with line of belly	12
Objections: Narrow at top or bottom, small girth, cramped or tucked up.	
8. **Back and loin.**—Back straight or slightly arched; medium breadth, with nearly uniform thickness from shoulders to hams and full at loins; sometimes higher at hips than at shoulders .	15
Objections: Narrow, creased or drooped behind shoulders; surface ridgy or uneven.	
9. **Sides and ribs.**—Sides full, smooth, firm, carrying size evenly from shoulder to hams; ribs, strong, well sprung at top and bottom . . .	8
Objections: Sides thin, flat, flabby or creased, or ribs not well sprung.	
10. **Belly and flank.**—Straight and full, devoid of grossness; flank full and running nearly on line with sides	6
Objections: Belly sagging or flabby; flank thin or tucked up.	
11. **Hams and rump.**—Hams of medium width, long and deep; rump slightly rounded from loin to root of tail; buttock full and neat and firm, devoid of flabbiness or excessive fat	10

SCALE OF POINTS FOR HAMPSHIRE SWINE, continued

		Perfect score
	Objections: Ham narrow; cut too high in crotch, buttock flabby; rump too flat, too narrow or too steep, or peaked at root of tail.	
12.	**Legs and feet.**—Legs medium length, set well apart and squarely under body, wide above knee and hock and rounded and well muscled below, tapering; bone medium; pasterns short and nearly upright; toes short and firm, enabling the animal to carry its weight with ease	10
	Objections: Legs too long, slim, crooked, coarse or short; weak muscles above hock and knee bone; large and coarse legs without taper; pasterns too long to correspond with length of leg, too crooked or too slender; feet long, slim and weak; toes spreading, too long, crooked or turned up.	
13.	**Tail.**—Medium length, slightly curled	1
	Objections: Coarse, long, clumsy, swinging like a pendulum.	
14.	**Coat.**—Fine, straight, smooth	2
	Objections: Bristles or swirls, coarse or curly.	
15.	**Color.**—Black, with exception of white belt encircling the body, including fore-legs	2
	Objections: White running high on hind-legs or extending more than one-fourth length of body, or solid black.	
16.	**Size.**—Large for condition; boar two years old and over, 450; sow, same age, 400; eighteen months, boar, 350; sow, 325; twelve months, boar or sow, 300; six months, both sexes, 140	5
17.	**Action and style.**—Active, vigorous, quick and graceful; style attractive and spirited . . .	4
	Objections: Dull, sluggish and clumsy.	
18.	**Condition.**—Healthy, skin free from all defects; flesh evenly laid on and smooth and firm, not patchy, and devoid of all excess of grossness .	4
	Objections: Skin scurfy, scaly, mangy or otherwise unhealthy: hair harsh; dwarfed or cramped, not growthy.	
19.	**Disposition.**—Docile, quiet and easily handled .	3
	Objections: Cross, restless, vicious or with no ambition.	
	Perfection	100

History.

The original American name of this breed is Thin Rind. In 1904, the organization which looks after the interests of the breed, changed the name to Hampshire, which is now the official name of the breed. It is the latest addition to the recognized pure breeds of swine in the United States.

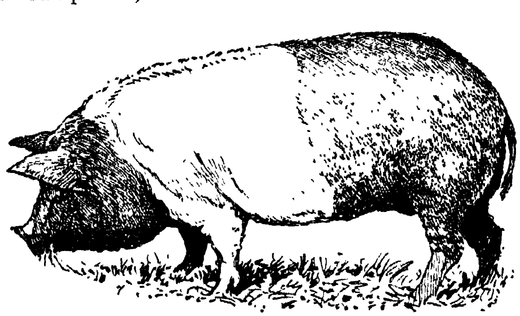


Fig 669. Hampshire hog.

According to Mr. H. F. Work, the Hampshire traces to pigs brought to Massachusetts from Hampshire, England, about 1820 or 1825. It is also stated that descendants of this importation were taken to Kentucky about 1835. Be this as it may, the breed has been known in Kentucky for many years. Various theories regarding its origin have been advanced, but it seems impossible to secure definite and reliable information regarding the origin of the breed.

Distribution.

According to the secretary of the Hampshire Association, the breed is to be found in a large number of states, but the numbers in any one state are not large, comparatively speaking. Kentucky, Illinois and Indiana are probably the most important centers, but the breed has been making rapid progress of late. One or two very small importations have been made into Canada, but no registrations have yet been made in the Canadian Record.

Types.

Hampshires do not vary extremely in type, if we may judge by exhibits made at the leading shows, and the breed has not yet attained sufficient prominence to admit of an intelligent study of this phase of the question.

Uses.

It is claimed for the Hampshire that it is a bacon hog. In regard to this claim, we must bear in mind that what the American packer calls a bacon hog is a very different animal from the one required to make a "Wiltshire side" for export to England. It is animals suitable for making "Wiltshire sides" that have given rise to the market term, "bacon hog," and if judged from this standpoint, the Hampshire would fall far short of requirements. It is altogether too short in the side, too thick in the shoulder, and too heavy in the neck to make a number one "Wiltshire side," but as a light-weight hog for supplying bacon for home consumption, the Hampshire answers the purpose very satisfactorily.

In early maturity and feeding qualities, the Hampshire seems to be giving good satisfaction to those who are handling it, and it is highly esteemed as a grazer. It is an active, hardy breed, and there is no apparent reason why it should not give as good an account of the food it consumes as any other breed.

In quality of flesh, the Hampshire has an enviable reputation. It has made an excellent record in the dressed carcass competitions at the International Live Stock Exposition at Chicago, and the packers appear to regard it with high approval. Its strong point is the large proportion of lean.

The Hampshire ranks high in regard to fecundity, and appears to be one of the most prolific of American breeds so far as we are able to investigate the matter.

The value of the Hampshire for cross-breeding is not well known, but it seems reasonable to suppose that it should cross well with the fat types of hogs.

Organizations and records.

The American Hampshire Swine Record Association was organized in 1893, and published its first herdbook in 1906. Three volumes of the herdbook have been published to date (1908), with a total of 4,775 registrations.

Literature.

For references, see page 646.

Large Yorkshire or Large White Swine. Figs. 670, 671.

By *G. E. Day.*

The Large Yorkshire is an English breed of swine. It possesses very superior bacon qualities, and stands preëminent among the bacon-hog types.

Description.

The Large Yorkshire is one of the largest breeds of swine. The snout is of medium length, and should possess little or no dish, although there is a moderate dish in the face. The jowl is of good width and muscular, but it should not be flabby, nor heavily loaded with fat. The ears are rather large, and sometimes inclined forward, especially in old animals, but they should be firmly attached to the head, should not be coarse, and should be fringed with fine hair. The shoulder and back are only of medium width, the side is long, and the ham carries very little surface fat, making it lighter than the ham of the fat or lard type of hog. The flesh of the ham should be carried well round the inside of the thigh, and the ham generally shows a tapering appearance toward the hock. The bone is fairly heavy, but should be clean and flinty in appearance. The leg is longer than the leg of the fat hog. The color is white. Black hair on any part should disqualify. Black or blue spots on the skin do not disqualify, but are objected to, and the aim of breeders is to reduce these spots to a minimum. In the description of the snout of the Large Yorkshire, the standard of excellence prepared by the American Yorkshire Club falls short of the ideal of the best breeders of the present day. The short, turned-up snout is no longer popular, although it is very frequently seen.

Following is the standard of excellence and scale of points adopted by the American Yorkshire Club in 1899:

Scale of Points for Large Yorkshire Swine

	Perfect score
1. **General outline.**—Long and deep in proportion to width, but not massive; slightly arched in the back, symmetrical and smooth, with body firmly supported by well-placed legs of medium length	5
2. **Outline of head.**—Moderate in length and size, with lower jaw well sprung, and considerable dish toward snout, increasing with advanced maturity	4

Scale of Points for Large Yorkshire Swine, continued

	Perfect score
3. **Forehead and poll.**—Wide	1
4. **Eye.**—Medium size, clear and bright	1
5. **Jowl**—Medium, not carried too far back toward neck, and not flabby	1
6. **Snout.**—Turning upward with a short curve, increasing with age.	1
7. **Ear.**—Medium in size, standing well out from the head, of medium erection and inclining slightly forward	1
8. **Neck.**—Of medium length, fair width and depth, rising gradually from poll to withers; muscular, but not gross, evenly connecting head with body	3
9. **Outline of body.**—Long, deep and of medium breadth, equally wide at shoulder, side and hams; top-line slightly arched, under-line straight	7
10. **Back.**—Moderately broad, even in width from end to end; strong in loin, short ribs of good length	10
11. **Shoulder.**—Large but not massive, not open above	6
12. **Arm and thigh**—Broad and of medium length and development	2
13. **Brisket.**—Wide and on a level with under-line	3
14. **Side.** Long, deep, straight and even from shoulder to hip	8
15. **Ribs.**—Well arched and deep	5
16. **Heart girth and flank girth.**—Good and about equal	8
17. **Hind-quarters.**—Long, to correspond with shoulder and side; deep, with moderate and gradual droop to tail	5
18. **Ham.**—Large, well let down on thigh and twist, and rear outline somewhat rounded	10
19. **Twist.**—Well down and meaty	1
20. **Tail.**—Medium, not much inclined to curl	1
21. **Legs.**—Medium in length, strong, not coarse, but standing straight and firm	5
22. **Hair.**—Abundant, long, of medium fineness, without any bristles	4
23. **Skin.**—Smooth and white, without scales, but dark spots in skin do not disqualify	2
24. **Color.**—White on every part	1
25. **Movement.**—Active, but not restless	5
Perfection	100

History.

The large Yorkshire undoubtedly descended from a race of a large, coarse-boned, leggy, white hogs, that were common in Yorkshire and adjacent counties for so long a time that we have no definite knowledge of their origin. These coarse white hogs possessed the merit of size, and hence it was possible to improve them by crossing with finer breeds, and still retain plenty of size in the improved type. It is only within the past sixty or seventy years that any marked improvement was effected in the Large White hogs of Yorkshire. According to Sidney, the first important step was the crossing of the Yorkshire with the white Leicester, a large breed, but finer in bone, and more easily fattened than the original Yorkshire. Perhaps the most important improvement was effected by crossing with the Small Whites, or, as they are now called in America, the Small Yorkshires. These small, fine-boned, easily fattened hogs, produced a very marked

improvement in the old Yorkshire, which has been still further improved and brought up to its present high standard of excellence by judicious selection in the hands of skilful breeders.

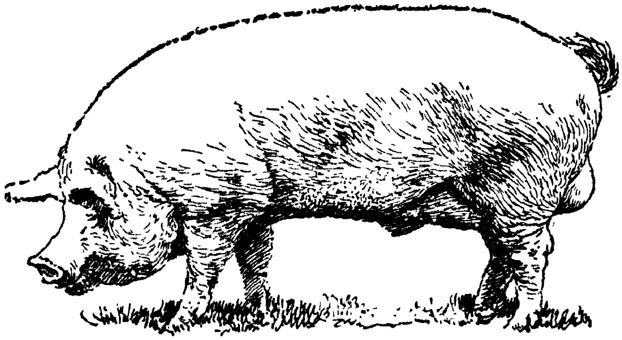


Fig. 670. Large Yorkshire boar.

In America.—Large White hogs have been brought to the United States at different times during the past century, but the improved type of Large Yorkshires can scarcely be said to have attained a standing in the United States until 1892. Among the first to import them into Canada were some of the packing houses, who brought them into the country for the purpose of improving the bacon qualities of Canadian hogs. During the past twenty or twenty-five years, the breed has made wonderful progress in Canada, and has more animals recorded in the Canadian record than any other breed.

Distribution.

On the American continent, Large Yorkshires have made the greatest progress in Canada, owing to the fact that Canadians have been paying special attention to the production of bacon hogs. In the United States, their progress has been comparatively slow, and it is doubtful whether they will ever attain a high degree of popularity, especially in the corn-belt, where the fat type of hog seems better adapted to prevailing conditions. Minnesota is the headquarters for the breed, and they are also found in North Dakota, South Dakota, Iowa, New York, Ohio, Michigan, Wisconsin, Virginia, Massachusetts, and some other states. In Canada, they are to be found in every province, Ontario taking the lead.

Large Yorkshires occupy a very important place in Denmark, and there are comparatively few countries of any importance, from a live-stock stand-point, where the breed is not represented.

Types.

Large Yorkshires vary more or less in type, and it requires skill in selection to keep them true to the best type. Some years ago, it was common to find Large Yorkshires with very short, turned-up snouts. This style of snout is generally associated with a rather heavy jowl, neck and shoulder, which, from a bacon standpoint, are very objectionable. Another type, which is frequently seen, has a long, scrawny neck, narrow chest, and long coarse-boned legs. This type is generally very long in the side and smooth in the shoulder, both very desirable features from a bacon curer's standpoint; but it has too much bone and too coarse a skin, and lacks in quantity and quality of flesh. It is also a somewhat slow feeder, and is therefore objectionable from a farmer's standpoint. The most desirable type has sufficient length of side to make a good packer's hog, and has constitution and quality to such a marked degree that it is unexcelled from a feeder's standpoint.

Uses.

As previously intimated, the Large Yorkshire is especially valued for bacon-production, where a long side abounding in lean meat, and a light shoulder and neck are especially desirable. The large size and strong bone of this breed make it valuable for crossing on breeds that have become unduly fine in the bone, and lack size. It crosses remarkably well with the Berkshire, Chester-White and Poland-China, as well as other fat breeds, increasing the size and the proportion of lean meat without impairing the feeding qualities.

The Large Yorkshire is frequently spoken of as being "slower maturing" than the fat types of hogs, but this is not a fair way of stating the case. From the bacon curer's standpoint, the breed will reach desirable market weight and condition at as early an age as any existing breed, and there are few breeds that equal it in this respect. Therefore, from the standpoint of the farmer who is feeding hogs for the bacon trade, no breed excels the Yorkshire in point of early maturity. For the production of a fat carcass at an early age, however, the Large Yorkshire is not so well adapted. It is a special-purpose breed, and must be regarded as such.

From the fact that the Large Yorkshire grows rapidly and develops bone and muscle more rapidly

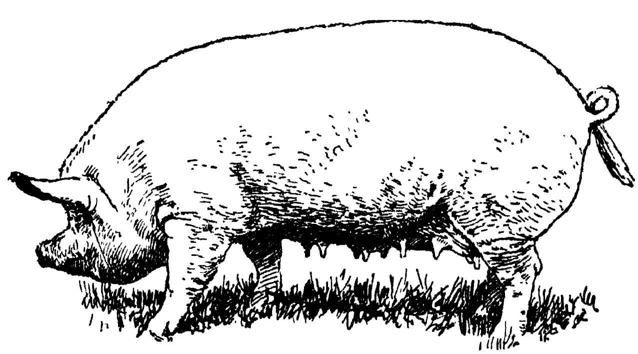


Fig. 671. Large Yorkshire sow.

than it develops fat, feeders are inclined to regard it as an expensive hog to feed. Careful experiments go to show that such is not the case, and that, under most circumstances, it is capable of

giving as good results for food consumed as any other breed. It is, perhaps, not so well adapted to grazing as some other breeds, and a hot sun is likely to blister the skin. It is probable, too, that an exclusive corn ration would not agree with it so well as with some other breeds that have been developed especially to consume corn. The Large Yorkshire has been developed in a country where a mixed ration is used, and where feeding in pens is largely practiced; and under such conditions it gives an excellent account of the food it consumes.

For quality of bacon, the Large Yorkshire is rivaled only by the Tamworth. The large proportion of lean to fat, the thick, fleshy belly and great length of side, render the breed peculiarly desirable from a bacon curer's and a consumer's standpoint. At the Provincial Winter Fair, held annually at Guelph, Canada, there is the largest exhibit of bacon carcasses of any show in existence, and the Yorkshires and Yorkshire grades always carry off the largest share of the prizes.

Large Yorkshire sows are very prolific, and are splendid nurses. The boars are exceptionally prepotent and stamp their character and color on their progeny to a remarkable degree, no matter what they are crossed with.

Organizations and records.

The American Yorkshire Club was organized in 1892, and the first herdbook was published in 1901. Up to 1908, three herdbooks had been published, in which 10,582 animals are recorded. In Canada, Yorkshires are recorded in the Dominion Swine Breeders' Record, and up to January 1, 1908, 29,185 animals had been recorded. For further information regarding Canadian records, see under Berkshires.

Literature.

For references, see page 646.

Poland-China Swine. Fig. 672.

By *G. E. Day.*

Poland-China swine are entirely the product and development of American swine-breeders. They are of the lard-hog type.

Description.

The Poland-China is a medium-sized breed, and, as commonly bred, is not so large as the large type of Berkshire; but the average Poland-China is well up to the average Berkshire in weight. The face is slighty dished; the jowl full and heavy; the ears should be fine, firmly attached to the head, and about one-third of the ear should droop. The neck is short, thick, and heavily arched on top. The shoulder is heavy, the side rather short, but deep, and the back wide, with a slightly arched top-line. The whole hind-quarter is heavily fleshed, the ham being exceptionally wide and deep. The legs are short, and the bone fine, breeders having gone to an extreme in regard to fineness of bone in many cases. Some years ago, Poland-Chinas were freely marked with white, but the fashionable color today is black, with six white points, namely, white in face, on the feet, and tip of the tail. A limited number of white markings on other parts of the body are not seriously objected to.

Following is the description and scale of points adopted by the National Association of Expert Judges of Swine:

Scale of Points for Poland-China Swine

	Perfect score
1. **Head**	4
2. **Eyes**	2
3. **Ears**	2
4. **Neck**	2
5. **Jowl**	2
6. **Shoulders**	6
7. **Chest**	12
8. **Back and loin**	14
9. **Sides and ribs**	10
10. **Belly and flank**	4
11. **Ham and rump**	10
12. **Feet and legs**	10
13. **Tail**	1
14. **Coat**	3
15. **Color**	3
16. **Size**	5
17. **Action and style**	3
18. **Condition**	2
19. **Disposition**	2
20. **Symmetry of points**	3
Perfection	100

1. *Head.*—Head should be broad, even and smooth between and above the eyes; slightly dished, tapering evenly and gradually to near the end of the nose; broad lower jaw, head inclined to shortness, but not enough to give the appearance of stubby nose; and in male, a masculine expression and appearance.

Objections.—Head long, narrow between the eyes; nose uneven and coarse; too large at the muzzle or the head too short; not full or high above the eyes, or too much wrinkled around or above the eyes.

2. *Eyes.*—Full, clear, prominent and expressive.

Objections.—Dull expression, deep set or obscure. Sight impaired by wrinkles, fat or other cause.

3. *Ears.*—Ears attached to the head by a short, firm knuck, giving free and easy action; standing up slightly at the base to within two-thirds of the tip, where a gentle break or droop should occur; in size neither too large nor too small, but even, fine, thin, leaf shape; slightly inclined outward.

Objections.—Large, floppy, straight, upright or coarse; knuck long, letting the ear droop too close to the head and face, hindering the animal of free use of the ears.

4. *Neck.*—Short, wide, even, smooth, well arched; rounding and full from poll to shoulder, with due regard to the characteristics of the sex.

Objections.—Long, narrow, thin and drooping from the shoulder to the poll, with unevenness caused by wrinkles or creases.

5. *Jowl.*—Full, broad, deep, smooth and firm, carrying fullness back to near point of shoulders, and below line of lower jaw so that the lower line will be as low as breastbone when head is carried up level.

Objections.—Light, flabby, thin and wedge-shaped, deeply wrinkled, not drooping below line of lower jaw, and not carrying fulness back to shoulder and brisket.

6. *Shoulders.*—Broad and oval at the top, showing evenness with the back and neck, with good width from

the top to the bottom, and even smoothness extending well forward.

Objections.—Narrow at the top or bottom; not so deep as the body; uneven width. Shields on pigs under eight months of age, or showing too much shield at any age.

7. *Chest.*—Large, wide, deep and full; even under-line to the shoulder and sides with no creases; giving plenty of room for heart and other organs, making a large girth, indicating much vitality. Brisket smooth, even and broad, wide between legs, and extending well forward, showing in front.

Objections.—Pinched appearance at the top or bottom, or tucked in back of fore-legs; showing too narrow between the legs; not depth enough back of the shoulder. Brisket uneven, narrow, not prominent.

8. *Back and loin.*—Broad, straight or slightly arched, carrying same width from shoulder to ham, surface even, smooth, free from lumps, creases or projections, not too long, but broad on top, indicating well-sprung ribs; should not be higher at hip than at shoulder and should fill out at junction with side so that a straight-edge placed along at top of side will touch all the way from point of shoulder to point of ham; should be shorter than lower belly line.

Objections.—Narrow, creased back of shoulders, swayed or hollow, drooping below a straight line; humped or wrinkled; too long or sun-fish shaped; loin high, narrow, depressed or humped up; surface lumpy, creased, ridgy or uneven, width at side not so much as shoulder and ham.

9. *Sides and ribs.*—Sides full, firm and deep, free from wrinkles; carrying size down to belly; even from ham to shoulder. Ribs of good length, well sprung at top and bottom.

Objections.—Flat, thin, flabby, pinched, not so full at bottom as at top; drawn in at shoulder so as to produce a crease, or pinched and tucked up and in as it approaches the ham; uneven surface; ribs flat or too short.

10. *Belly and flank.*—Belly broad, straight and full, indicating capacity and room, being about the same or on a level at the flank with the under chest-line. Under-line straight or nearly so, and free from flabby appearance.

Objections.—Belly uneven and flabby, or apparent looseness in the make-up. Pinched up in the flank or flanked too high.

11. *Ham and rump.*—Hams broad, full, deep and long from rump to hock; fully developed above and below, being wide at the point of the hip, carrying width well down to the lower part of the hams; fleshy, plump, rounding, fulness perceptible everywhere. Rump rounding and gradually sloping from the loin to the root of the tail; broad and well developed all along from loin, and gradually rounding to the buttock; lower front part of ham should be full, and stifle well covered with flesh. Even width of ham and rump with the back, loin and body; even a greater width as to females not objectionable.

Objections.—Ham, short, narrow, too round or slim; not filled out above or below, or unshapely for deep meat; nor so wide as the body, back or loin; too tapering or small. Rump narrow or pointed, not plump or well filled, or too steep from loin to the tail.

12. *Legs and feet.*—Legs medium length, straight, set well apart and squarely under body, tapering, well muscled and wide above knee and hock; below hock and knee round and tapering, capable of sustaining weight of animal in full flesh without breaking down; bone firm and of fine texture; pasterns short and nearly upright. Feet firm, short, tough and free from defects.

Objections.—Legs long, slim, coarse, crooked; muscles small above hock and knee; bone large, coarse; as large at foot as above knee; pasterns long, slim, crooked or weak; the hocks turned in or out of straight line; legs too close together; hoofs long, slim and weak; toes spreading or crooked or unable to bear weight of animal without breaking down.

13. *Tail.*—Tail of medium length and size, smooth and tapering well, and carried in a curl.

Objections.—Coarse and long without a curl; short, crooked or stubby; too small, even, not tapering.

14. *Coat.*—Fine, straight, smooth, lying close to and covering the body well; not clipped, evenly distributed over the body.

Objections.—Bristles, hair coarse, harsh, thin, wavy or curly; swirls, standing up, ends of hair split and brown, not evenly distributed over all of the body except belly. Clipped coats should be cut 1.5 points.

15. *Color.*—Black, with six (6) white points: Tip of tail, four white feet and white in face on the nose or on the point of lower jaw; all to be perceptible without close examination. Splashes of white on the jaw, legs or flank, or a few spots of white on the body not objectionable.

Objections.—Solid black, white mixed or sandy spots; speckled with white hairs over the body; mottled face of white and black, hair mixed, making a grizzly appearance.

16. *Size.*—Large for age. Condition, vigor and vitality to be considered. There should be a difference between breeding animals and those kept or fitted for the show, of at least 25 per cent in size. In show condition, or when fat, a two-year-old boar should weigh not less than six hundred (600) pounds, and a sow not less than five hundred (500) pounds. Boar one year and over, four hundred (400) pounds; sow, three hundred and fifty (350) pounds. Boar, eighteen months, five hundred (500) pounds; sow, four hundred and fifty (450) pounds. Boars and sows six months old, not less than one hundred and sixty (160) pounds. All hogs in just fair breeding condition, one-fourth less for size. The keeping and chance that a young hog has cuts a figure in his size and should be considered, other points being equal. Fine quality and size combined are desirable.

Objections.—Overgrown; coarse, flabby, loose appearance, gangling, hard to fatten; too fine, undersize; short, stubby, inclined to chubby fatness; not a hardy, robust animal.

17. *Action and style.*—Action vigorous, easy and graceful. Style attractive; high carriage; and in males, testicles should be prominent and of about the same size, and yet not too large and pouchy.

Objections.—Clumsy, slow, awkward movement; low carriage; waddling or twisting walk; a seeming tired or lazy appearance; not standing erect and firm.

18. *Condition.*—Healthy, skin clear of scurf, scales and sores; soft and mellow to the touch; flesh fine; evenly laid on and free from lumps and wrinkles. Hair soft and lying close to body; good feeding qualities.

Objections.—Unhealthy, skin scaly, wrinkled, scabby or harsh; flabbiness or lumpy flesh; too much fat for breeding. Hair harsh, dry and standing up from body; poor feeders; deafness, partial or total.

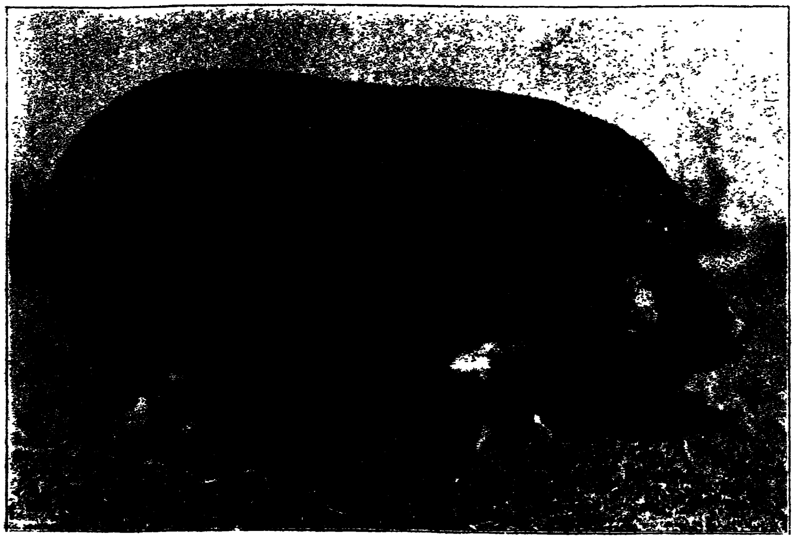
19. *Disposition.*—Lively, easily handled and seemingly kind, responsive to good treatment.

Objections.—Cross, sluggish, restless, wild or of a vicious turn.

20. *Symmetry or adaptation of points.*—The adaptation of all the points, size and style combined to make the desired type or model.

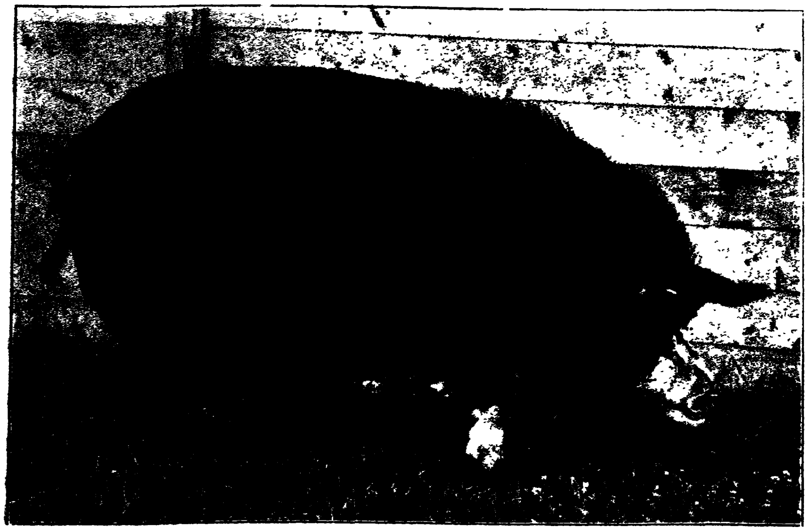
History.

The Poland-China originated in Butler and Warren counties, in Ohio. These two counties are drained by the Great Miami and the Little Miami rivers. The valley of the Miami is a very fertile district, and its name is closely associated with the early history of this breed. The history of the origin of Poland-China swine is not altogether clear, and some points have been the subject of



Poland-China boar

Tamworth boar



Berkshire boar

Hampshire sows

Plate XXV. Breeds of colored hogs

lengthy controversies. From the varying theories and claims put forward, we may accept the following statements as being reasonably accurate. Previous to 1816, the Russia and Byfield breeds were largely used for crossing on the common hogs of the Miami valley. These were both white breeds, possessing more or less merit as feeders. In 1816, the Society of Shakers, of Union Village, Warren county, brought a boar and three sows from Philadelphia. The pigs were represented to the Shakers as being of pure Chinese blood, and they were called Big Chinas. The boar and two of the sows are said to have been pure white, and the other sow was white, with some sandy and black spots. These Big Chinas and their descendants were extensively crossed on the hogs then in the county, and the resulting type came to be known as the Warren county hog. The Big China was a medium-sized breed, of fine bone and good feeding qualities, and its use on the hogs of Warren county effected a marked improvement. It is also stated that subsequent to the introduction of the Big China, other China hogs of finer and smaller type were brought into the county. In 1835 or 1836, Berkshires were introduced and extensively used, and about 1839 or 1840, the Irish Grazier was imported and used on these pigs of complicated breeding in Warren county. The Irish Grazier was a white breed of considerable merit and did its share toward modifying the Miami valley hogs. It was also said by some persons that a Poland breed was used for crossing on Warren county hogs, while others maintained that no such breed was ever introduced. An extended controversy ensued, which was finally ended by the findings of a committee that was appointed to investigate the origin of the breed, and which reported its findings to the National Swine Breeders' Convention held in Indianapolis in 1872. This committee reported against the theory that a Poland breed had been used, but recommended that the name Poland-China be recognized as the accepted name of the breed. The recommendation was adopted, and since that time the breed, which previously had been known by a great variety of names has been known as the Poland-China. It is said that since 1845 no outside blood has been infused into this breed.

Distribution.

The Poland-China is widely distributed over the United States. The principal states in which the breed is found, according to the Secretary of the American Poland-China Record Association, are Iowa, Illinois, Texas, Missouri, Kansas, Nebraska, Indiana, Ohio, Minnesota, South Dakota, Wisconsin, Oklahoma, and Michigan, but there are few states where Poland-Chinas are not to be found.

In Canada, the breed has not obtained a very strong foothold, and has rather decreased in numbers during recent years. The strong demand for the bacon type in Canada is mainly responsible for this fact. Outside of the United States and Canada the breed is but little known.

Types.

As is the case with other breeds, the Poland-China differs more or less in the hands of different breeders. The older type of Poland-China was a larger, more rangy, and heavier-boned hog than the Poland-Chinas seen in the show-rings of today. Breeders of Poland-Chinas have gone rather to an extreme, on the whole, in the matter of selecting

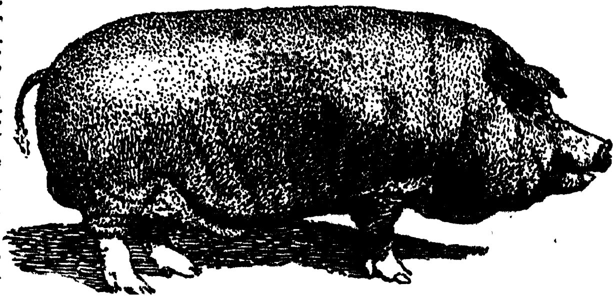


Fig. 672. Poland-China boar.

for fineness of bone, and the result, in many cases, is a hog that lacks somewhat in size and in fecundity. These facts have been brought forcibly before breeders during recent years, and any defects of the nature stated will be remedied, no doubt, by thoughtful breeders. Even now, we can see evidences of a change in methods, and there is little doubt that the Poland-China will be bred to retain its high quality without sacrificing its utility.

Uses.

The Poland-China has been developed especially to meet the market demand for a fat or lard hog. Its heavy shoulder, wide back, and heavily developed hams, render it an exceptionally good yielder from the packer's standpoint.

The quality of the meat produced by the Poland-China has frequently been criticised because of its large proportion of fat to lean. The development of a tendency to produce lean along with fat has been largely overlooked in bringing this breed to its present stage of perfection from a feeder's standpoint, but it appears to meet the demands of the American packer, and he is willing to pay top market price for it.

In early maturity, that is, in ability to produce a finished fat carcass for the packer at an early age, the Poland-China is unexcelled. It has been bred for early maturity for generations, and has attained an enviable reputation in this connection.

As a feeder, the Poland-China is a favorite with corn-belt farmers. The breed has been developed on corn-feeding, and seems to thrive on an exclusive corn ration better than many other breeds. In a colder climate, and on a mixed ration, the Poland-China might not show to so good advantage as some other breeds, but for the purpose of turning corn into pork, it is difficult to beat. The Poland-China has also demonstrated its usefulness as a grass hog, making good gains on pasture with a

light grain ration. Experiments with breeds of swine have resulted differently at different stations, and it would seem that economy of production is more a question of individuality than of breed. Their exceptional tendency to fatten renders animals of this breed especially valuable for crossing purposes, and the Poland-China is highly esteemed for crossing on other breeds, as well as on common, or grade stock. A cross between the large Yorkshire and the Poland-China has been found to give an excellent hog, both from a farmer's and a packer's standpoint. For crossing with the Berkshire, Duroc-Jersey and Chester-White, the breed is very highly esteemed, and the cross-breds are generally regarded as superior to the pure-breds for feeding purposes.

The most serious criticism directed against the Poland-China is on the score of fecundity. In any breed in which so much attention has been paid to the development of fine bone and a very marked tendency to fatten, it is only natural to expect that there would be some loss of fecundity, and statistics appear to indicate that the Poland-China is no exception to the rule. This criticism applies especially to the very fine-boned types.

Organizations and records.

Organizations in the interests of Poland-Chinas are numerous. The largest organization is the American Poland-China Record Association, which was organized in 1878. It published its first herdbook in 1879, and has published fifty volumes to date (1908), containing the names of 278,000 animals. The Ohio Poland-China Record was organized in 1877, and up to 1906 had published twenty-seven volumes. The Central Poland-China Association was organized in 1880, and published twenty-six volumes of its Record up to 1906. In 1906, the Ohio and Central Associations amalgamated under the name of the National Poland-China Record Company, and since amalgamation two volumes have been published, which are numbered twenty-eight and twenty-nine, beginning where the Ohio herdbooks left off. The Ohio Association recorded 103,000 head, the Central Association 48,000 head, and since amalgamation, 13,000 head have been recorded in the two volumes of the National. The Northwestern Poland-China Swine Association was organized in 1881. The Standard Poland-China Record Association was organized in 1887, and has published some twenty volumes since that time. The Southwestern Poland-China Record Association was organized in 1896, and has published two herdbooks, with 2,378 registrations. These associations in the main are thrifty and influential, as indicated by the large number of registrations; but the best interests of the breed demand greater unity of effort and of ideals.

In Canada, Poland-Chinas are recorded in the Dominion Swine Breeders' Record, but only 3,367 hogs of this breed have been recorded to January 1, 1908.

Literature.

For references, see page 646.

Small Yorkshire or Small White Swine. Figs. 673, 674.

By *G. E. Day.*

The Small Yorkshire is an English breed of pigs, and may be said to be of the fat-hog type. It is of relative unimportance in America.

Description.

The Small Yorkshire may be considered the smallest breed of swine kept in the United States. It has a very short, turned-up snout, wide face, small, erect ears, heavy jowl, and a very short, heavy neck. The body is short, thick, deep, and smooth, and the legs are very short and fine in the bone. The color is white and the hair is abundant, but fine..

Following is the description and scale of points adopted by the American Yorkshire Club.

Scale of Points for Small Yorkshire Swine

	Perfect score
1. **General outline.**—Wide and deep in proportion to the length, straight above and below, and short in head, neck, body and limbs	5
2. **Outline of head.**—Short, abrupt, inclining to fine, and possessed of much dish and downward springing under the jaws	4
3. **Forehead and poll.**—Wide	1
4. **Eye.**—Medium size, clear and bright	1
5. **Jowl.**—Large, smooth and carried well back toward the neck	1
6. **Snout.**—Short, turning upward somewhat with a deep indenture or curve immediately above it	1
7. **Ear.**—Small, thin, erect and inclining slightly forward rather than backward at the tips	1
8. **Neck.**—Short, wide and deep, the width slightly increasing towards the shoulders	3
9. **Outline of body.**—Short, broad, deep and straight above, below, and on the sides	7
10. **Back.**—Very broad, of even width and straight from withers to tail head	10
11. **Shoulder.**—Large, smoothly and evenly developed, and blending perfectly with neck and crops	6
12. **Arm and thigh.**—Moderately wide, tapering nicely down, and inclining to be short	2
13. **Brisket.**—Wide and on level with under-line	3
14. **Side.**—Deep, thick in every part, straight and even from shoulder to hip	8
15. **Ribs.**—Widely and deeply sprung	5
16. **Heart and flank girth.**—Excellent in proportion to the length of body and about equal	8
17. **Hind-quarters.**—Relatively long; broad in every part and deep, with but little lowering toward the tail head	5
18. **Ham.**—Large, well let down at thigh and twist and inclined to be straight behind	10
19. **Twist.**—Well down and full	1
20. **Tail.**—Fine, short and inclined to curl	1
21. **Legs.**—Short, fine rather than coarse, strong, straight, and placed well apart	5
22. **Hair.**—Abundant, fine, even in quality	4
23. **Skin.**—Smooth and white and free from creases and scales	2
24. **Color.**—White on every part	1
25. **Movement.**—Gentle and easy but not sluggish	5
Perfection	100

History.

The Small Yorkshire comes from England, where it goes by the name of "Small White," the name "Small Yorkshire" being of American origin. The breed is thought to be of Chinese origin, modified, of course, by the methods of the English breeders. Various types or strains of Small Whites have been bred in England, but at present they are all classed as one breed.

Fig. 673. Small Yorkshire boar.

In America.—The Small Yorkshire was brought to the United States, according to Curtis, in 1860 and numerous importations were made between that time and 1878.

Distribution.

Small Whites are found in many parts of England. In the United States, under the name of Small Yorkshire, small herds are to be found, mainly in the East. The breed no longer attracts much attention.

It is somewhat difficult to give any very important use for Small Yorkshires in America. The breed matures very early, and fattens easily, but produces excessively fat meat. It is probably most suitable for the cottager who wants a pig that can be matured with a small amount of feed.

There is no American breed that requires crossing with a breed like the Small Yorkshire, unless it is the "Razorback," and the Essex seems to be rather better adapted to this purpose, as it will stand the hot sun of the South better than a white pig. Any advantage from crossing with ordinary breeds would accrue to the Small Yorkshire, rather than to the other breed.

Fig. 674. Small Yorkshire sow.

The Small Yorkshire is not noted for fecundity, and it would seem as though the breed were destined gradually to disappear, unless some unforeseen conditions arise which call for the services of a pig of this kind.

Organizations and records.

The American Small Yorkshire Club was organized in 1878, and has recorded some 1,500 pigs in its herdbook. The American Yorkshire Club also records Small Yorkshires, the Small Yorkshires being recorded in what is called Class A and the Large Yorkshires in Class B. In England, the breed is registered in the herdbook of the National Pig Breeders' Association. No Small Yorkshires have been recorded under this name in Canada.

Literature.

For references, see page 646.

Suffolk Swine. Fig. 675.

By *G. E. Day.*

The Suffolk is an English breed of swine, closely identified with the Small Yorkshire, and of little importance in America. It may be classed with the fat- or lard-hog types. It is best adapted to intensive conditions, where land for grazing is scarce and soiling food is used in addition to pasture.

Description.

At the National Swine Breeders' Convention at Indianapolis, Indiana, in 1872, the following description of the Suffolk was approved: "Head small, very short; cheeks prominent and full; face dished; snout small and very short; jowl fine; ears short, small, thin, upright, soft and silky; neck very short and thick, the head appearing almost as if set on front of shoulders, no arching of crest; chest wide and deep; elbows standing out; brisket wide but not deep; shoulders thick, rather upright, rounding outward from top to elbow; crops wide and full, long ribs, well arched out from back, good length between shoulders and hams; flanks well filled out and coming well down at ham; back broad, level, straight from crest to tail, not falling off or down at the tail; hams wide and full, well rounded out, twist very wide and full all the way down; legs small and very short, standing wide apart—in sows, just keeping belly from the ground; bone fine, feet small, hoofs rather spreading; tail small, long and tapering; skin thin, of a pinkish shade, free from color; hair fine and silky, not too thick; color of hair, pale yellowish white, perfectly free from any spots or other color; size, small to medium." In size, the Suffolk is probably slightly larger than the Small Yorkshire, but it is practically the same breed.

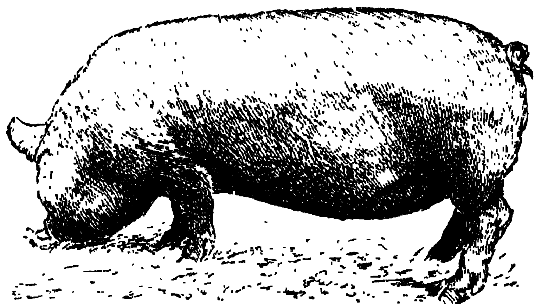


Fig. 675. Suffolk hog.

Following is the scale of points adopted by the American Suffolk Association:

SCALE OF POINTS FOR SUFFOLK SWINE

		Perfect score
1.	**Color.**—White	2
2.	**Head.**—Small, broad, and face dished	3
3.	**Ears.**—Fine, erect, slightly drooping with age	2
4.	**Jowl.**—Full and neat	1
5.	**Neck.**—Short, full and slightly arched	3
6.	**Shoulders.**—Broad and deep	7
7.	**Girth around heart**	6
8.	**Back.**—Straight, broad, level	12
9.	**Sides.**—Deep and full	6
10.	**Ribs.**—Well sprung	7
11.	**Loin.**—Broad and strong	12
12.	**Flank.**—Well let down	2
13.	**Ham.**—Broad, full, deep	12
14.	**Tail.**—Medium, fine and curled	2
15.	**Legs.**—Fine, straight and tapering	3
16.	**Feet.**—Small	3
17.	**Hair.**—Fine and silky, free from bristles	3
18.	**Action.**—Easy and graceful	4
19.	**Symmetry.**—Adaptation of the several parts to each other	10
	Perfection	100

History.

The Suffolk is undoubtedly of the same origin as the Small Yorkshire, and is an offshoot of the Small White breed in England. There is no such breed as a White Suffolk recognized in England, but the name Suffolk is sometimes applied locally to the Small Black breed, of which the Essex is a representative.

In America.—The breed is said to have been brought to the United States in 1855, but it has never made much progress, and seems to be losing ground steadily.

Distribution.

The so-called Suffolk pig is confined to the United States and Canada, although it has practically disappeared from the latter country. In the United States it is found mainly in the Mississippi valley, but herds are not at all numerous.

Uses.

What has been said regarding Small Yorkshires under this heading applies here, as the breeds are essentially the same. [See page 674.]

Organizations and records.

The American Suffolk Association was organized many years ago, but no herdbook has yet been published. In Canada, Suffolks are recorded in the Dominion Swine Breeders' Record, only 850 animals having been recorded up to January 1, 1908.

Literature.

For references, see page 646.

Tamworth Swine. Fig. 676.

By *G. E. Day.*

Tamworth swine are of the bacon type, and as such have been accorded a high place by breeders. They are much more popular in Canada than in the United States.

Description.

According to the standard of excellence adopted by the National Pig Breeders' Association of Great Britain, the Tamworth should have "golden red hair on a flesh-colored skin, free from black." However, the shade of red varies considerably in individuals, and a chestnut shade is very common. In aged animals, it is not uncommon to see such a dark shade of chestnut that the casual observer might mistake it for a dull black. The snout is long and straight, and the ear large, and somewhat more pointed than the Yorkshire ear. The ears should be firmly attached to the head. The jowl is narrower and lighter than that of the Yorkshire, the neck and shoulder are light, the back and loin of medium width, and the side of good length and only moderately deep. Deficiency of ham is a common weakness of the Tamworth. Since the Tamworth belongs to the bacon type, it is not desirable that it should have a heavy, fat ham like a fat hog; but the ham is often lacking seriously even from a bacon standpoint, and the breeders are making an effort to strengthen this point. The Tamworth is a large hog, strong in the bone, and looks leggy beside a hog of the fat type. The Tamworth and Large Yorkshire are similar in size, and are the two leading breeds of the bacon type.

Following is the standard of excellence adopted by the National Pig Breeders' Association of Great Britain.

STANDARD OF EXCELLENCE FOR TAMWORTH SWINE

1. **Color.**—Golden red hair on a flesh-colored skin, free from black.
2. **Head.**—Fairly long, snout moderately long and quite straight, face slightly dished, wide between ears.
3. **Ears.**—Rather large, with fine fringe, carried rigid and inclined slightly forward.
4. **Neck.**—Fairly long and muscular, especially in boar.
5. **Chest.**—Wide and deep.
6. **Shoulders.**—Fine, slanting, and well set.
7. **Legs**—Strong and shapely, with plenty of bone and set well outside body.
8. **Pasterns.**—Strong and sloping.
9. **Feet.**—Strong and of fair size.
10. **Back.**—Long and straight.
11. **Loin.**—Strong and broad.
12. **Tail.**—Set on high and well tasseled.
13. **Sides.**—Long and deep.
14. **Ribs.**—Well sprung and extending well up to flank.
15. **Belly.**—Deep, with straight under-line.
16. **Flank.**—Full and well let down.
17. **Quarters.**—Long, wide, and straight from hip to tail.
18. **Hams.**—Broad and full, well let down to hocks.
19. **Coat.**—Abundant, long, straight, and fine.
20. **Action.**—Firm and free.

Objections: Black hair, very light or ginger hair, curly coat, coarse mane, black spots on skin, slouch or drooping shoulders, wrinkled skin, inbent knees, hollowness at back of shoulders.

History.

The Tamworth takes its name from Tamworth, in Staffordshire, England. It is also to be found in adjoining counties. It is of ancient and uncercertain origin, and there seems to be no well authenticated account of where it came from. As first known, it was an extremely leggy, narrow

type of hog, but it has been greatly improved during the past thirty years. Whether this improvement was wrought solely by selection, or whether cross-breeding was resorted to, is uncertain. Professor Long favors the theory that the Tamworth was crossed with some white breed, but apparently no proof exists as to the correctness or incorrectness of this claim. Although it is one of the oldest

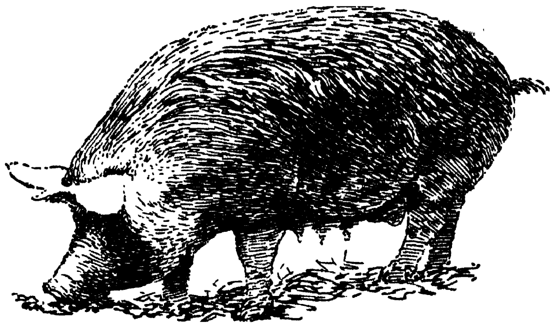


Fig. 676. Tamworth sow.

English breeds, it was not given a separate class at the Royal Agricultural Society's Show until 1885.

In America.—Representatives of the Tamworth breed were brought to the United States nearly thirty years ago, but the breed does not make rapid progress. The long snout tends to prejudice the average farmer, and the fact that the production of bacon hogs receives little or no encouragement in the United States also tends to work against the general adoption of the breed.

Like the Large Yorkshire, the Tamworth was brought to Canada by the packers some twenty years ago, with a view to improving the bacon qualities of Canadian hogs, and large numbers have been imported by Canadian breeders during the past twenty years. The Tamworth has not attained the degree of popularity in Canada that is enjoyed by the Yorkshire, although it is always well represented at the leading Canadian fairs.

Distribution.

As already stated, the Tamworth has not made rapid progress in the United States, although representatives are to be found in Illinois, Kentucky, Iowa, Kansas, Texas, Wisconsin and Ohio. In Canada, it is more numerous in Ontario than in any other province, but it is to be found in practically every province. England and Canada are the two leading countries in the production of this breed.

Uses.

The Tamworth is especially adapted to the production of bacon. Its light shoulder, neck and head, its good length of side, and its tendency to produce a large proportion of lean to fat, render it well suited to the bacon curer's requirements. Being a large breed, and strong in the bone, it has become popular for crossing on finer and fatter breeds in districts where it is well known. A cross between the Tamworth and the Berkshire is very popular in Canada.

As to early maturity, it is similar to the Large Yorkshire. For producing fat carcasses at an early age, it is unsuitable, as this is not the purpose for which it is bred. It will reach suitable weight for the bacon curer, however, at as early an age as any of the fat breeds, and will not carry the excessive fat which renders the fat breeds unsuitable for bacon purposes. For bacon-production, therefore, it matures early, and it is from the bacon standpoint that the Tamworth must always be judged.

There is a popular belief among farmers that the Tamworth does not make economical use of food. A good deal of this prejudice is due to the appearance of the animal, and the man who is used to the short, thick, fine-boned type of hog, finds difficulty in reconciling himself to a hog of Tamworth type. Experiments show, however, that the Tamworth is capable of making good use of the food it consumes, and that it compares very favorably with other breeds in this respect. Like the Yorkshire, it is rather better adapted to pen feeding than to pasture. It has been impossible to secure much information regarding its ability to stand exclusive corn-feeding. Available information indicates that the breed is not particularly well adapted to this purpose.

It is asserted by some persons that Tamworths produce higher class bacon than any other breed, but this is too sweeping an assertion, and when they have come together in dressed-carcass competitions, the Large Yorkshire has won the largest share of prizes. There is no question, however, that the Tamworth produces excellent bacon, which is well mixed with lean of fine quality. The Large Yorkshire and Tamworth are the only strictly bacon breeds with which we are familiar in America.

Tamworth sows are prolific and are good mothers. The boars are prepotent, but perhaps scarcely equal to the Large Yorkshire in this respect. According to Shaw, the Tamworth as compared with the Chester-White shows greater adaptability, is more active as a grazer, more hardy, and produces a superior quality of bacon.

Organizations and records.

The American Tamworth Swine Record Association was organized in 1897. The first volume of the herdbook was published in 1903, and up to January 1, 1908, two volumes had been published, in which 4,510 animals are recorded. In Canada, Tamworths are recorded in the Dominion Swine Breeders' Record. Up to January 1, 1908, 6,970 animals had been recorded. [For further information regarding Canadian swine organizations, see under *Berkshire swine*, on pages 659 and 660.

In Great Britain, Tamworth swine are recorded in the herdbook of the National Pig Breeders' Association.

Literature.

For references, see page 646, where a general list of swine books is given.

Victoria Swine. Fig. 677.

By *G. E. Day.*

The Victoria breed of swine was originated in America, but unlike the Poland-China, the great American breed, it has not gained much popularity. It is of the fat-hog type.

Description.

The Victoria ranks with the medium-sized breeds, being similar to the Berkshire in size. The snout is rather short, the face dished, and the ear, which is of only medium size, is firmly attached to the head and erect. The body is broad and deep, and the hams

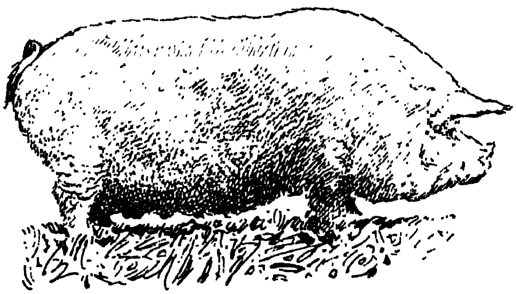


Fig. 677. Victoria sow.

and shoulders reasonably well developed. The color is white, with occasional dark spots on the skin.

Following is the scale of points adopted by the Victoria Swine Breeders' Association:

Scale of Points for Victoria Swine

	Perfect score
1. **Color.**—White, with occasional dark spots in the skin	2
2. **Head.**—Small, broad, and face medium dished	3
3. **Ears** —Fine, pointing forward	2
4. **Jowl.**—Medium size and neat	1
5. **Neck.**—Short, full and well arched	3
6. **Shoulders.**—Broad and deep	7
7. **Girth around heart**	6
8. **Back.**—Straight, broad and level	12
9. **Sides.**—Deep and full	6
10. **Ribs.**—Well sprung	7
11. **Loin.**—Broad and strong	12
12. **Flank.**—Well let down	2
13. **Ham.**—Broad, full and deep, without loose fat	12
14. **Tail.**—Medium fine and curled	2
15. **Legs.**—Fine and straight	3
16. **Feet.**—Small	3
17. **Hair.**—Fine and silky, free from bristles	3
18. **Action.**—Easy and graceful	4
19. **Symmetry.**—Adaptation of the several parts to each other	10
Perfection	100

Detailed description.

1. *Color.*—White, with occasional dark spots in the skin.
2. *Head and face.*—Head rather small and neat. Face medium-dished and smooth; wide between eyes; tapering from eyes to nose.
3. *Eyes.*—Medium size; prominent, bright, clear and lively in young, and quiet expression in aged animals.
4. *Ears.*—Small, thin, fine, silky; upright in young pigs, pointing forward and slightly outward in aged animals.
5. *Neck.*—Medium wide, deep, short, well arched, and full at top.
6. *Jowl.*—Medium full, nicely rounded, neat and free from loose, flabby fat.
7. *Shoulders.*—Broad, deep and full, not higher than line of back, and as wide as top of back.
8. *Chest.*—Large, wide, deep and roomy, with large girth back of shoulders.
9. *Back and loin.*—Broad, straight, or slightly arched; carrying same width from shoulders to ham; level and full at loin, sometimes slightly higher at hips than at shoulders.
10. *Ribs and sides.*—Ribs well sprung at top; strong and firm; sides deep, full, smooth and firm; free from creases.
11. *Belly and flank.*—Wide, straight and full; as low or slightly lower at flank than at chest. Flank full and nearly even with sides.
12. *Hams and rump.*—Hams long, full and wide, nicely rounded; trim and free from loose fat. Buttocks large and full, reaching well down to hocks. Rump slightly sloped from end of loin to root of tail.
13. *Legs and feet.*—Legs short, set well apart and firm; wide above knee and hock, tapering below. Feet firm and standing well up on toes.
14. *Tail.*—Small, fine and tapering, nicely curled.
15. *Coat.*—Fine and silky, evenly covering the body.
16. *Size.*—Boar two years old and over when in good condition should weigh not less than 500 pounds; sow same age and condition, 450 pounds. Boar twelve months old, not less than 300 pounds; sow in good flesh, 300 pounds. Pigs five to six months old, 140 to 160 pounds.
17. *Action.*—Easy and graceful, but quiet.
18. *Condition.*—Healthy; skin clean, and white or pink in color, free from scurf; flesh firm and evenly laid on.
19. *Disposition.*—Quiet and gentle.

Disqualifications.

Color.—Other than white or creamy white, with occasional dark spots in skin.

Form.—Crooked jaws or deformed face; crooked or deformed legs; large, coarse, drooping ears.

Condition.—Excessive fatness; barrenness; deformity in any part of the body.

Pedigree.—Not eligible for record.

History.

At one time there were two breeds of Victoria swine, but only one breed and type is now recognized. The breed that has secured the ascendancy was originated by George F. Davis, Dyer, Indiana, and was formed by combining the blood of the Poland-China, Berkshire, Chester-White, and Suffolk, accompanied by careful selection to a type. The origin of the breed dates to about 1870.

The other breed was established about 1850 by Colonel F. D. Curtis, of New York state, who is said to have used Irish Grazier, Byfield, Yorkshire, and Suffolk blood. This breed seems to have disappeared as a recognized pure breed.

Distribution.

According to Professor Plumb, the Victoria is found mainly in Indiana, Ohio, and Illinois, with scattered herds in a few other states. A very few Victorias have found their way into Canada, but the breed is now nearly extinct in that country.

For some reason the breed does not make much progress.

Uses.

The Victoria belongs to the fat class. We have little information regarding its early maturity and feeding qualities, but from the fact that it does not increase rapidly in popularity, it would seem that the public does not recognize any outstanding merit, or advantage over other breeds. In quality of meat, it appears quite equal to other breeds, and it has a good reputation for being prolific.

Its value for cross-breeding has not been well demonstrated.

Organizations and records.

The Victoria Swine Breeders' Association was organized in 1886, and the Victoria Swine Record is published by this association. In Canada, only nine animals of this breed have been recorded in the Dominion Swine Breeders' Record.

Literature.

For references, see page 646.

Miscellaneous Breeds of Swine.

By *G. E. Day.*

There are certain little-known breeds or types of hogs that are of interest historically, or in restricted areas. In order to make the discussion of swine in this cyclopedia more nearly complete, brief notes on several of these breeds are introduced.

HISTORIC BREEDS.

It is an old opinion, apparently well substantiated, that the English swine, from which the modern American types are derived, sprung from breeds introduced from the east, as Chinese, Neapolitan and Siamese pigs. Even in such a noted live-stock country as Great Britain, the pigs of less than a century ago, were, on the whole, a rather undesirable lot, according to descriptions that have been handed down to us. Long legs, general coarseness, and slow fattening propensities were then commonly characteristic of British breeds. It is out of the question, even if it were desirable, to attempt to trace all the steps that led to the establishment of British breeds as we know them today, but there is no doubt that much of the improvement came from the introduction of foreign breeds, which were crossed on the native stock. Although these foreign breeds are now practically unknown in Great Britain and America, there are three breeds whose influence has been so far-reaching as to render them worthy of at least a passing notice.

The introduction into England of these Chinese, Neapolitan and Siamese pigs wrought a revolution among the earlier types of swine, and the crossing and inter-crossing of various types, which followed the introduction of foreign blood, and which is too intricate and too little known to admit of complete investigation, resulted eventually in the English breeds of the present day.

Chinese, Neapolitan, and Siamese swine were also imported into the United States. The great bulk of American foundation stock came from Great Britain, especially England, and as was the case in England, the use of Chinese, Neapolitan, and other similar blood, followed by the crossing of various local types, has led to the establishment of what are known as American breeds.

Chinese swine.—Youatt writes of these swine as follows: "There are two distinct varieties, the white and the black; both fatten readily, but from their diminutive size attain no great weight. They are small in limb, round in body, short in the head, wide in the cheek, and high in the chine; covered with very fine bristles growing from an exceedingly thin skin; and not peculiarly symmetrical, for, when fat, the head is so buried in the neck that little more than the tip of the snout is visible."

Neapolitan swine.—This breed came from the country about Naples, in Italy, and was also of the extremely fine-boned, easily fattened type. It is especially noted for the part it played in the formation of what is now known as the Essex breed.

Siamese swine.—Mr. A. B. Allen, who bred Siamese swine many years ago, describes them in part as follows: "They varied in color from deep, rich plum to dark slate and black; had two to three white feet, but no white on the legs or other parts of the body. The head was short and fine, with a dished face and rather thin jowl; ears short, slender, and erect, shoulders and hams round, smooth and extra large; back broad and slightly arched; body of moderate length, deep, well ribbed up, and nearly as round as a barrel; . . . legs fine and short; hair soft, silky, and thin; no bristles, even on boars; . . . flesh firm, sweet and very tender, with less lean than in the Berkshire."

MULE-FOOT HOG.

A hog in which the hoof is single has recently come into notice. Its origin seems to be obscure, being attributed by one account to a cross of a Berkshire boar on a native razorback sow in Arkansas previous to 1900, and by others to introductions from various foreign countries. The National Mule-foot Hog Record Association, recently organized in Indiana, makes the following statements: foot solid, short, smooth, enabling the animal to carry its own weight with ease; color black, with white points admissible; boar two years and over should weigh 500 pounds, sow same age 450 pounds; neither a lard or bacon hog, but a medium between the two.

LARGE BLACK SWINE.

The Large Black, as its name implies, is a large breed, all black in color, and possessing very large drooping ears. In general conformation it approaches the bacon type, having a good length of side, medium width of back and shoulder, a rather light neck and jowl, and fairly heavy bone.

The Large Black hog is the latest addition to the recognized pure breeds of swine in Great Britain.

The origin of the breed is not well known, but it has been bred for a great many years in the east and south of England. It is hardly known outside of England, and is not widely distributed even in England, being confined mainly to the southern part of the country. Some years ago, representa-

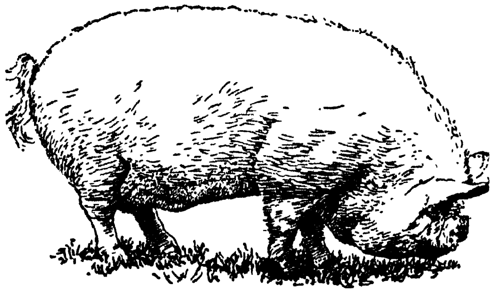


Fig. 678. Middle White boar.

tives of the breed were brought to the Central Experimental Farm, Ottawa, Canada, but did not prove very satisfactory. At present, the breed is practically not represented on the American continent.

The main claims for the Large Black are its bacon qualities, its fecundity, and its value as a scavenger. Its bacon is highly esteemed in England, containing, as it does, a large percentage of lean. It is worthy of note, however, that at Ottawa the bacon of the Large Black was not equal to that of the Large Yorkshire or the Tamworth. The sows are excellent nurses, and the breed is regarded as a first-class farmer's breed in England.

The interests of the breeds in England are looked after by "The Large Black Pig Society of Great Britain." This organization publishes the only herdbook for the breed.

MIDDLE WHITE OR MIDDLE YORKSHIRE SWINE. Fig. 678.

The Middle White, as the name implies, is intermediate in type between the Large White and the Small White. It is recognized in England as a distinct breed, but it is a difficult breed to describe, because of its variations. Some represenitives of the breed might easily pass as Large Whites, and from this extreme they shade down nearly all the way to the Small White type. There is little doubt that many so-called Large White pigs carry some Middle White blood, and that many Middle Whites, or pigs containing a large percentage of Middle White blood, have been brought to America and passed as Large Whites. Generally speaking, they are smaller than the Large Whites, have a shorter side, shorter leg, finer bone, and a heavier neck and jowl. They usually have a shorter snout than the Large White, and have more dish in snout and face. They belong to the fat type of hog.

The Middle White originated from a cross between the Large White and the Small White breeds. Even at present, pigs may appear in Large White litters that are classed by their breeders as Middle Whites, so that it sometimes happens that Large Whites and Middle Whites may *come from the same litter, especially in those herds in which Middle White blood is occasionally* used to refine the Large White. Sometimes Middle Whites are produced by one cross of Small Whites on Large Whites, and animals produced in this way should scarcely be regarded as a distinct breed.

The Middle White is unknown outside of its native country, and if any have been brought to America, they were introduced under the name of Large Yorkshire.

The utility of the Middle White is necessarily limited. The practice of crossing, followed by many breeders, has told against the usefulness of the breed. Middle Whites which have been bred pure for a number of generations would no doubt prove satisfactory, but so many of them possess recent crosses of other blood, that the breed as a whole lacks prepotency and trueness to type. The mixing of Middle White blood with that of Large White, as practiced by many English breeders, cannot be too strongly condemned. A so-called Large Yorkshire boar produced in this way may look more attractive to the inexperienced breeder of Large Yorkshires than a pure Large Yorkshire, but he makes a very unsatisfactory sire. Breeders of Large Yorkshires soon learn to avoid boars showing any evidence of Middle White blood.

RAZORBACK SWINE. Fig. 679.

Whether it is strictly correct to call the "Razorback" a distinct breed may be open to question, but since it represents a type of hog existing in some parts of the United States, it should receive passing notice.

The "Razorback" is characterized by long, coarse legs and snout; coarse ears, coarse skin, and a bristly coat; narrow back, slab sides, no hams worth mentioning, and an absence of any tendency to fatten. In spite of its undesirable qualities, it is more or less amenable to improvement, and some of the finer breeds, notably the Essex, have been crossed on it with a fair degree of success. Its hardiness and its ability to look after itself, are its main recommendations.

Fig. 679. Razorback sow and litter.

There is little doubt that the "Razorback" is a degenerate descendant of pigs brought into the country by the earliest white settlers. Hunger, exposure and the necessity for looking after itself and foraging its own living, have been the chief factors in evolving the type.

The "Razorback" is now found almost exclusively in a comparatively limited area of the South,

and this area is becoming more and more restricted as improved agriculture advances. It is only a question of time until the type entirely disappears.

Literature.

For references, see page 646.

TURTLES AND TURTLE-FARMING. Figs. 680, 681.

By *E. A. Andrews.*

Along the coasts of America, four kinds of marine turtles lay their eggs in the sandy beaches, where they are left to develop by themselves, if such enemies as the bear and man do not discover them. While the flesh of the green turtle is most highly esteemed, and the shell of the "hawk's bill" or tortoise-shell turtle is greatly valued, a third of these four, the loggerhead, is also used as food, so that much profit would come from an increase in the abundance of these marine turtles. However, as they are wide wanderers, seeking food over large areas and coming to shore only to lay their eggs, there is no question of private turtle-farming for these large oceanic reptiles, although the government might well take steps to lessen the too rapid extermination of the race by diminishing the destruction of eggs and young, just as has been done for equally pelagic fish.

The green turtle feeds on marine grass, off the Florida coasts, in comparatively shallow water, but the females, after mating in May, migrate hundreds of miles to lay their eggs on the Bahama banks and small islands. The eggs are laid in batches of 130 to 180, and it is thought that each female may lay four batches in June, July and August, but no more for one or two years. The eggs require ten to twelve weeks to hatch, and so many are eaten by gulls and sharks that probably only 2 to 3 per cent survive the first week out of the shell.

Fresh-water and land turtles.

Among the fresh-water and land turtles the problem is somewhat different, and, in time, a turtle-farming industry will arise. There are some fifty kinds of these land and fresh-water turtles: snappers, mud turtles, painted turtles and terrapins, pond turtles and wood-terrapin (*Chelopus insculptus*), box turtles, tortoises or gophers of Florida, and the soft-shelled turtles. The wood-terrapin eats berries and insects, and, in New York, is protected by a state law from capture and sale.

Of these several turtles, the terrapins and snappers are most often used as food, although the soft-shelled turtles are sold in the markets, both North and South. The snapping turtles may be readily kept alive and fed on animal refuse, which, however, they must take under water to swallow. On the market they bring but ten cents a pound, so that there is not the incentive to artificial culture that there is in the very high-priced diamond-back terrapin. The snapping turtles leave the water to lay their eggs—some two dozen—in the earth, and if there were a sufficient supply of cheap animal food, a business of rearing these turtles in confined areas might be developed. However, like the bull-frog, these large carnivorous animals belong naturally to the conditions prevailing in wild, unsettled regions, and man will not find it profitable to rear carnivorous animals as food unless they may roam over unutilized regions, or for some reason they become esteemed far above their real food value. This latter condition is met in the diamond-back terrapin, which sells for $60 to $70 per dozen when eight inches long. When about seven and one-half inches long they bring $6 each; at eight inches long, bring $8; but when five inches long,

Fig. 680. Terrapin (*Malaclemmys centrata concentrica*).

bring only $1.50. Every year these turtles are becoming scarcer and the price higher. To take their places, many of the less-esteemed species of the same genus, and of the related forms of painted turtles (*Chrysemys*), are sold as "sliders," at $1.25 to $1.50 each for large specimens.

The diamond-back terrapin differs from the others in living in salt and brackish water along the coast and up tidal rivers. In captivity, it does not thrive without the addition of some salt to the water, becoming, in fresh water, infected with a fungus that causes its death. However, it needs fresh water also. In captivity, it may be fed on chopped clams, meat, fish, crustacea and periwinkles. As in the case of the snapper, all the feed is taken under water, so that these turtles cannot be reared without sufficient water. In nature, the diamond-back turtle eats such soft shell-fish as its weak jaws enable it to crush, and also a considerable amount of soft roots and shoots of plants.

The different sorts of diamond-back turtles have been divided by Hay into the following species: *Malaclemmys centrata*, the Carolina terrapin; *M. centrata concentrica*, the famous Chesapeake bay terrapin; *M. macrospilota*, the Florida terrapin; *M. pileata*, the Louisiana terrapin; *M. litteralis*, the Texas terrapin. The life history and habits are best known in the case of the Carolina terrapin. It has been found as far north as Buzzard's bay. The adults sleep in the bottom of ponds and rivers all winter and mate in the spring. The males are so small, not exceeding five inches as measured lengthwise of the under shell, that they are excluded from the market by the laws of some states, which fix the limit at five or six inches. Hence, there is great destruction of females and rapid diminution in the number of eggs that might be laid. The female lays the eggs in May or June, digging a hole in the bank, five or six inches deep, and carefully covering the five to twelve eggs with earth and then leaving them to hatch by themselves. This they do in six to twelve weeks, accord-

ing to the temperature of the season. Soon after hatching, the young bury themselves in the marsh and there remain all winter and perhaps part of the following summer also. They grow about one inch a year up to five inches, and then more slowly. They reach a maximum length of eight to nine inches and are supposed to live twenty-five to thirty years. Apparently the diamond-back does not migrate but remains in the region where it was hatched or where it was put, so that it would be readily possible to protect and increase the local supply.

Turtle-farming industry.

In Japan.— It is only in Japan that a profitable turtle-farming industry has been developed. There, the soft snapping-turtle (*Trionyx Japonicus*) is reared from eggs laid by captive turtles in special

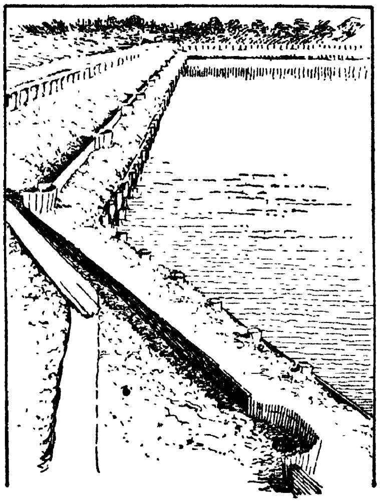


Fig. 681. Arrangement for catching newly-hatched turtles.

ponds made for the business. The farms of the Hattori family have shown a healthy and steady growth since their establishment in 1875, with a stock of fifty turtles. In 1904, the three "farms" of 25, 7 and 2 acres were expected to yield about 4,100 batches of eggs, or say 82,000 eggs, hatching 70,000 young and yielding some 60,000 marketable turtles at the end of the third year.

One of these "farms" is a collection of ponds fed by canals and separated by low board walls to confine the turtles. The ponds are but two to three feet deep, and as the turtles are shy and will not feed well in clear water, it has been found expedient to keep carp and other fish in the same ponds, in order that they may stir up the mud to conceal the turtles. The eggs are laid in the steep banks of earth, and each batch is at once covered with wire netting by the attendants. When the young hatch, they are prevented from crawling into the water by planks on edge, that divert them from a straight course to the water until they finally fall into sunken jars, whence they are removed by the attendants and placed in rearing ponds. There they are fed on chopped fish until they go into the winter sleep. Gradually they are given the food of the adults, and are finally not kept separate from large turtles. The young of three to five years are the most esteemed, and are the ones sold in the market. When six years old, they begin to breed, but are not yet at the maximum of reproductive power.

These farms have been successful because of the abundance of cheap animal food—a kind of clam, which is crushed under heavy millstones. The turtles are also given boiled wheat grains, dried fish scraps, silkworm pupæ, and other food.

In America, the so-called turtle-farms prove to be merely places for holding the stock for shipment to market, with the one important exception of the turtle-farm at Lloyds, Maryland. This is now under the control of the United States Bureau of Fisheries. It has been there demonstrated that young turtles may be secured from eggs laid in enclosed pens by the diamond-back terrapin. Whether the young can be reared profitably to a marketable size, remains to be demonstrated by this experimental farm. Although this industry is thus merely in the experimental stage, there is hope that if properly undertaken on a large scale, with large outlay and with the realization that some six years must elapse before the product of the hatched egg can be of marketable size, financial success might result.

As turtles lay but few eggs as compared with fish and crustacea, the first essential in turtle-farming is to have ponds with proper conditions of moisture and temperature in the neighboring shores, so that all the eggs laid in the ground may hatch. Another necessity is to protect the young turtles and to feed them enough, not only for growth, but to carry them safely through the long hibernating period of winter. On the other hand, the long life of the adults enables one to secure many successive broods from the same parents. At the best, only exceptional conditions of cheap, natural feeding-grounds and cheap labor may be utilized for profit in turtle-raising.

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